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PALEONTOLOGY.—Linter, *a new taxodont genus from the Upper Cretaceous of Texas.*[1] LLOYD WILLIAM STEPHENSON, U. S. Geological Survey.

An elegant little taxodont bivalve mollusk from the Nacatoch sand of the Navarro group of Texas appears to belong to a heretofore undescribed genus and species for which the name *Linter acutata* is now proposed. This shell has been found at three localities in Navarro County.

The genus is also represented by one specimen belonging to a distinct species, here named *Linter burrana*, from the San Miguel formation of Maverick County, Texas, a formation stratigraphically lower than the Nacatoch sand, and correlated with the upper part of the Taylor marl of central Texas.

These species belong to a group of taxodont shells having vertically striated ligamental areas, to which F. Stearns MacNeil, in an accompanying paper in this JOURNAL, and in a paper now in press as United States Geological Survey Professional Paper 189-A, applies the new family name Noetidae, based on the genus *Noetia* Gray, and the new subfamily name Trinacriinae, based on the genus *Trinacria*.

Genus LINTER Stephenson, n. gen.

Type species: *Linter acutata* Stephenson.

Etymology: Latin *linter*, a boat or skiff.

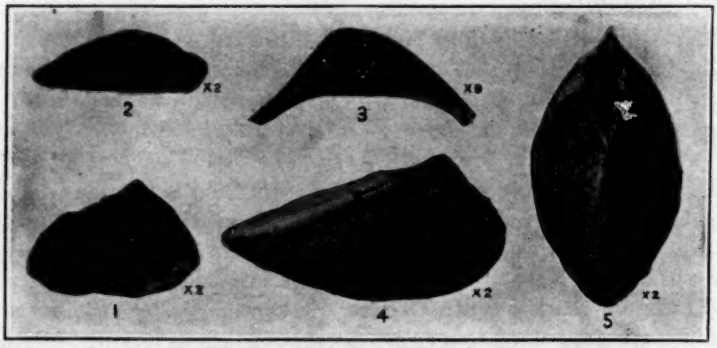
This genus is characterized by its long and sharply acute umbonal ridge, its short *Arca*-like hinge, and its broadly excavated triangular cardinal area situated mainly back of the beak; at the forward end of the area under the beak is a small, triangular, amphidetic, ligamental area, faintly striated at right angles to the hinge line; the rest of the area is smooth with only incremental lines showing. The hinge is slightly arched and is set with 10 or more irregular, short, transverse to slightly oblique teeth, separated by deep sockets.

The genus is represented by 8 specimens from Texas, 7 from the Nacatoch sand, described below under the specific name *Linter acutata*, and 1 from the stratigraphically lower San Miguel formation of Maverick County, described under the name *Linter burrana*.

[1] Published by permission of the Director, U. S. Geological Survey. Received September 13, 1937.

Linter acutata Stephenson n. sp. Figs. 1–3

Shell small, subtrigonal in outline, strongly convex. Beaks prominent, opisthogyrate, slightly separated, situated about 3/10 the length of the shell from the anterior extremity. The umbonal ridge is sharply angular, the median surface meeting the postero-dorsal slope at an acute angle, the crest of the ridge slightly overhanging as it approaches the beak. A broad, very shallow radiating depression extends to the postero-ventral margin in front of the umbonal ridge. The umbonal ridge stands higher than any other part of the shell, and from it the surface rounds down gently to the anterior and ventral margins; the posterodorsal slope is long, broad, and broadly excavated, the concavity being slightly modified by a broad median swell; this surface meets the cardinal area at a broad, obtuse angle. The cardinal



Figs. 1–5.—*Linter acutata* Stephenson. 1, side view of the holotype, a right valve, ×2 (U.S.N.M. no. 75974). 2, dorsal view of the holotype, ×2. 3, an enlarged, somewhat generalized drawing of the hinge and cardinal area of the holotype, ×9. Figs. 4, 5.—*Linter burrana* Stephenson. 4, side view of the holotype, ×2 (U.S.N.M. no. 75978). 5, dorsal view of the holotype, ×2.

area is triangular and broadly excavated; its lower straight edge is about 2.25 mm long in the holotype, and its posterior edge meets the posterodorsal slope at an obtuse angle; the anterior edge is partly concealed by the incurving of the sharp tip of the beak. Under the beak is a small, shallow, triangular, ligamental pit, which bears 5 or 6 obscure, transverse striations; the rest of the area is smooth with the exception of fine incremental lines. The hinge plate is short and narrow; as seen on the holotype it is obscure but appears to be set with 10 or more irregular taxodont teeth which centrally are nearly transverse to the hinge line but toward the ends become more or less oblique; the anterior teeth are chevron-shaped. The inner surface is partly exposed posteriorly in one shell and exhibits radial striae which are strongest near the pallial line. The anterodorsal margin is steeply inclined but curves below into the regularly rounded anterior margin, which in turn curves into the broadly convex to nearly straight ventral margin; the long, nearly straight, though slightly sinuous, posterodorsal margin meets the ventral margin at a sharp acute angle, forming a pointed extremity; the posterodorsal margin is strongly inclined forward and meets the hinge line at a very wide obtuse angle. The surface is marked with fine,

somewhat irregular incremental lines, crossed by very fine, obscure, radiating ridges which are a little stronger and wider apart on the antero- and posterodorsal slopes; the crossing of the two sets of lines tends to form a faint punctate sculpture; these features are too fine to show clearly in the illustration, and vary in strength on different individuals.

Dimensions of the holotype, a right valve: Length, 11.3 mm; height, 6.8 mm; convexity, 3 mm.

Types: Holotype, a right valve, U.S.N.M. no. 75974; 2 paratypes, U.S.N.M. no. 75975; 1 paratype, U.S.N.M. no. 75976; 4 paratypes, U.S. N.M. no. 75977.

Distribution in Texas.—Navarro group, Nacatoch sand: Public road south of the St. Louis Southwestern (Cotton Belt) Railroad, about 5 miles south-southwest of Corsicana, Navarro County (holotype and 2 paratypes, U.S. G.S. coll. 7573); from a small branch west of the Corsicana-Chatfield road, at the north end of M. R. and M. J. Thompson's property, 2 miles north of Corsicana, Navarro County (1 paratype, U.S.G.S. coll. 9553, collected by O. B. Hopkins in 1916); borrow pit just east of U. S. Highway 75, at foot of the north-facing slope of Chambers Creek valley, 4 miles north of the Court House at Corsicana, Navarro County (4 paratypes, U.S.G.S. coll. 17366).

Linter burrana Stephenson n. sp. Figs. 4, 5

One incomplete individual from the San Miguel formation, Maverick County, differs from *Linter acutata* mainly in its proportionately greater length and in its greater size, being nearly twice as long. In *L. acutata* the height is about 0.60 or 0.61 times the length, whereas in *L. burrana* the height is about 0.53 times the length. The specimen is an internal mold of both valves with the thin shell peeled off and lost from more than half the surface; the portion of the shell that remains is badly corroded, but shows the growth lines fairly completely; the posterodorsal slopes also show a series of fine, obscure radiating lines which are strongest near the acutely angular umbonal ridge, and become fainter inward toward the margin. The shell is gone from the beaks, and also from the forward portion of the cardinal area. The posterodorsal slopes are long, broad, broadly excavated, and extend with a moderately steep descent to the posterior extremity. The anterior adductor scar is proportionately small and elongated and is bordered posteriorly by a narrow radial internal rib that appears on the mold as a groove. The mold bears the impressions of fine, somewhat irregular, radiating, internal lines that are strongest toward the marginal ends.

Dimensions: Length 20.8 mm, height 11 mm, diameter 10.8 mm.

The species is accompanied at its type locality by a goodly number of poorly preserved pelecypods and gastropods (U.S.G.S. colls. 1887 and 8233), most of which have been only generically identified; among them are shells of *Ostrea saltillensis* Böse, and *Polinices rectilabrum* (Conrad).

Holotype: U.S.N.M. no. 75978.

Occurrence.—San Miguel formation (upper Taylor age): From layers of indurated calcareous sandstone in the north-facing slope of Sauz Creek, just north of the abandoned stone headquarters house of the old Burr Ranch, 2 miles northwest of Paloma siding, 23 miles north by east of Eagle Pass, Maverick County, Texas (U.S.G.S. coll. 8233).

PALEONTOLOGY.—*The systematic position of the pelecypod genus* Trinacria.[1] F. STEARNS MACNEIL, U. S. Geological Survey. (Communicated by LLOYD W. STEPHENSON.)

During the course of some researches into the structure and evolution of the ligament of arcid pelecypods the writer was fortunate enough to find, in a collection recently acquired by the U. S. National Museum, a few specimens of *Trinacria cancellata* (Deshayes) from the Calcaire Grossier, on which the fibrous ligament was perfectly preserved. These throw new light on the relationships of this genus. In addition some specimens of a new genus from the Upper Cretaceous of Texas, collected and described in manuscript by L. W. Stephenson of the U. S. Geological Survey, were recognized as representing a primitive type of Trinacriinae. It is the purpose of this paper to make the structure of the ligament of *Trinacria* known, to outline briefly the evolution of the genus, and to delimit the subfamily Trinacriinae which was recently proposed by the writer in U. S. Geological Survey Professional Paper 189-A.

The writer is indebted to the authorities of the U. S. National Museum for the privilege of studying Museum collections and to Dr. L. W. Stephenson for making the name of his Upper Cretaceous genus, *Linter*, available under separate title in this publication.

NOMENCLATURE

The availability of the name *Trigonocoelia* Nyst and Galeotti (1835) for the group of shells generally referred to as *Trinacria* Mayer (1868) has been a subject for difference of opinion since Deshayes usage of the former in 1860. Wood and Stoliczka expressed the opinion, which was probably shared by Conrad and Newton, that, inasmuch as the original list for *Trigonocoelia* contained two distinct genera, and one of them, the "pectunculacés" species, belonged to the genus *Limopsis* Sasso (1827) (type by monotypy, *Arca aurita* Brocchi), the name *Trigonocoelia* was still available for the "nuculacés" species. Mayer was apparently unaware that the original list for *Trigonocoelia* was divided into shells of two types, for he accused Deshayes of applying the name to an entirely different type of shell than that for which it was proposed. Mayer believed that Nyst and Galeotti's name was proposed as a substitute for *Limopsis*, because the latter was a hybrid name, and accepted the substitution on that

[1] Published by permission of the Director of the U. S. Geological Survey. Received September 8, 1937.

ground. He was thus incorrect in suppressing *Limopsis* and for the reasons he gave he was equally incorrect in proposing the new name *Trinacria*. His name is a valid one, however, by virtue of Herrmannsen's designation of *Arca aurita* Brocchi as the type of *Trigonocoelia* in 1849 (1). This is the first and only valid designation of a type for *Trigonocoelia* the writer has been able to find, and curiously enough it appears not to have been mentioned by later authors. On whatever nomenclatorial errors the name *Trinacria* has gained acceptance, Herrmannsen's designation settles the problem unless a contrary designation made between 1835 and 1849 is discovered. Dall raised the question as to whether *Trigonocaelix* Conrad (1865) [a typographical error] was not to have priority over *Trinacria*. Had not Conrad later corrected it to *Trigonocaelia* (2) a telling case might be made for it. Conrad's correction differs from Nyst and Galeotti's spelling by the diphthong *ae* for *oe*. Inasmuch as the name had been spelled indiscriminately before, Deshayes spelling it *ae* in the generic discussion and *oe* in the systematic text, and Chenu spelling it *oe* in his index and *ae* in the text it appears best to disregard both *Trigonocaelix* and *Trigonocaelia*.

RELATIONSHIPS OF TRINACRIA

Type (by subsequent designation, Gardner, U. S. Geol. Survey Prof. Paper 142-A, p. 21, 1926), *Trigonocoelia crassa* (Deshayes). Eocene, Paris Basin.

The almost universal assignment of *Trinacria* to the Limopsidae has been based on its possession of a deep ligamental pit, the assumption being that both *Trinacria* and *Limopsis* possessed a simple ligament connection partly submerged in the shell. A critical study of the structure of the ligament in these genera revealed that they are of two distinct types, that of *Limopsis* being a modification of the chevroned type, whereas that of *Trinacria* is a highly specialized form of the vertically striated type. This knowledge, along with the discovery of the Upper Cretaceous genus *Linter* (Fig. 1*a*), makes it possible to trace almost without interruption the steps in the evolution of *Trinacria* from its ancestral form to the highly specialized Miocene species occurring in the Alum Bluff group of Florida.

Presumably *Linter* was derived from some early member of the Striarcinae. It differs from *Breviarca* principally in being considerably lighter and in being strongly opisthogyrate, with a sharp umbonal keel and a small ligament area, nearly all of which is restricted to the part of the cardinal area anterior to the beaks. The cardinal area is

also well developed posterior to the beaks but devoid of ligament except for a narrow, sub-umbonal wedge. This posterior cardinal area appears to be slightly out of the plane of the ligament area. The vertical ligament elements of *Linter* are delicate, being of about the same texture as in *Breviarca*.

Development of *Trinacria* from *Linter* consisted of the beaks becoming more opisthogyrate and nearer the hinge line so as to cut off the anterior extension of the ligament. The posterior end of the cardinal area became shorter and more out of the plane of the ligament area, merging directly with the posterior slope. With the anterior part of the area cut off and the posterior end obsolete the narrow, subumbonal, posterior wedge of ligament remaining had to become thickened and submerged to retain strength. The central teeth on the types of *Linter* are not well preserved but there appears to be a break between the anterior and posterior rows. In *Trinacria*, owing to a much shortened hinge line, the two rows often come together but are sharply divided by a difference in direction.

Two species referable to *Trinacria* have been described from the Cretaceous, *Trinacria galeata* (Müller) (3) from the Greensands of Vaals, Aachen; and *Trinacria cor* Popenoe (4) from the Upper Cretaceous of California. A line drawing of the latter made from specimens kindly loaned the writer by W. P. Popenoe is shown in Fig. 1*b*. This species shows the characters mentioned above for early forms of *Trinacria*. The beaks are completely opisthogyrate, the umbonal keel very sharp, the ligament restricted and slightly entrenched, the cardinal area narrow and indistinct posteriorly, and the hinge line short.

Evolution within the genus *Trinacria* consisted of a secondary lengthening of the shell, orthogyration of the beaks and greater removal of them from the hinge line, lessening angulation and final rounding of the umbonal ridge, deeper entrenchment of the ligament with a tendency to grow more to the anterior in later species, and a greater separation of the anterior and posterior rows of teeth.

Trinacria deltoidea (Lamarck) (Calcaire Grossier) (Fig. 1*c*, drawn from a specimen from Houdan, France) shows the secondary orthogyration of the beaks with the consequent widening of the anterodorsal growth lines. The ligament is more deeply entrenched and extends more to the anterior than in the extremely opisthogyrate Cretaceous species. This species is very similar to *T. cuneus* (Conrad), from Claiborne, Alabama.

Trinacria cancellata (Deshayes) (Calcaire Grossier), the species in

which a perfectly preserved ligament was found, is very similar to *T. deltoidea*, differing mainly in being less inflated, more elongate, and in having more pronounced radial sculpture.

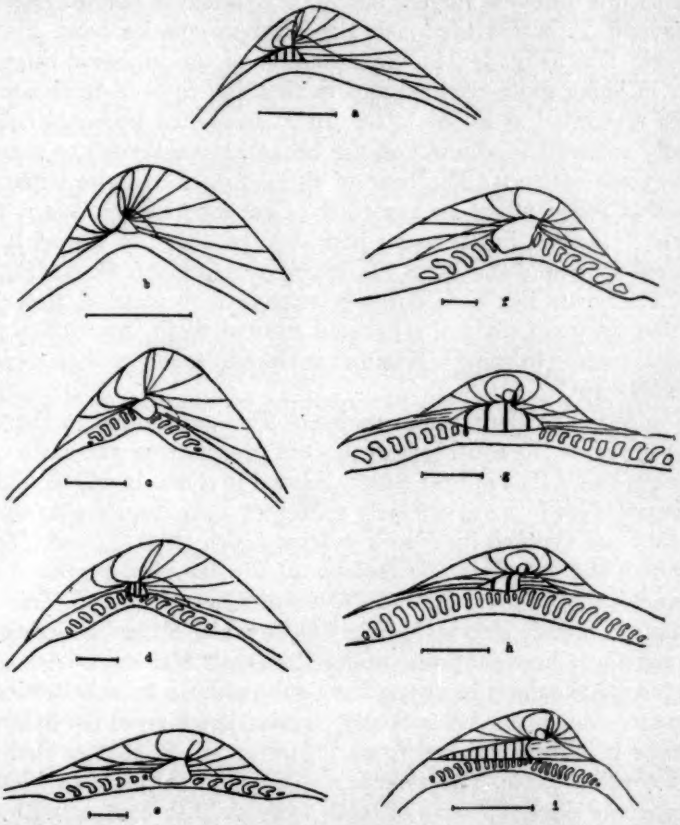


Fig. 1.—*a. Linter acutata* Stephenson. *b. Trinacria cor* Popenoe. *c. Trinacria deltoidea* (Lamarck). *d. Trinacria media* (Deshayes). *e. Trinacria meeki* Dall. *f. Trinacria pectunculariis* (Lea). *g. Halonanus* (*Trinacriella*) *cossmanni* (Dall). *h. Halonanus* (*Trinacriella*) *perplana* (Conrad). *i. Halonanus pulchra* (Gabb). The lengths indicated by the straight lines below the individual figures are over-all dimensions of the shell, natural size.

Remnants of the fibrous layer have also been observed in specimens of *T. media* (Deshayes) (Fig. 1*d*, Bartonian, Ezanville, France), a species closely related to *T. ledoides* (Meyer) from Claiborne. In these specimens the ligament material is somewhat disarranged but three ligament grooves are quite clearly indicated on one specimen.

This species is more elongate than *T. deltoidea* and the beaks are more orthogyrate. The umbonal ridge is not sharply carinate but sharply rounded and approaches that of *T. crassa* (Deshayes), the genotype, in which the umbonal ridge is definitely rounded in adults. *Trinacria media* and *T. crassa* approach the Miocene species from Florida, *T. meeki* Dall (Fig. 1*e*), in the rotundity of the umbonal ridge but differ in being more trigonal and in that the rows of teeth are not widely separated as in the latter. In *T. meeki* the umbonal ridge is broadly rounded in adults and the beaks have returned to a nearly orthogyrate attitude. The base of the ligament is more expanded. *Trinacria meeki* might be regarded as subgenerically distinct from typical *Trinacria*, but it seems just as satisfactory to regard it as a terminal species of the genus. *Trinacria pectuncularis* (Lea) (Fig. 1*f*) from Claiborne has a moderately expanded, somewhat anteriorly directed ligament pit and separated rows of teeth, but differs from *T. meeki* mainly in being higher and subquadrate rather than elongate and subovate.

In addition to the typical species of *Trinacria* found in the Claiborne group of the southeastern United States there exist two other groups of shells that appear closely related to them. It will be difficult to discuss these forms specifically until they have been monographed, but they are typified by *Noetia pulchra* Gabb (Fig. 1*i*) from Texas, for which the generic name *Halonanus* (5) has been proposed, and *Pectunculus perplanus* Conrad (6) from Claiborne; and *Trinacria perplana* (Conrad) Harris (7) (Fig. 1*h*) for which the subgeneric name *Trinacriella* is here proposed under the genus *Halonanus*.

Trinacriella ranges in shape from subquadrate to subelliptical or subovate, some forms being nearly circular. Aside from the difference in shape it is distinguished from *Trinacria* by its heavier shell and wider cardinal plate. The widening of the cardinal plate enabled the anterior and posterior rows of teeth to reestablish contact with each other and a series can be seen ranging from *T. cossmanni* Dall (Fig. 1*g*), in which the rows are well separated, to *T. perplana* (Conrad) (Fig. 1*h*) in which they run together. In addition the ligament pit exhibits a series ranging from nearly equilateral in *T. cossmanni* to more anteriorly directed as in *T. perplana* and *T. ellipsis* (Lea). The former pattern is regarded as aberrant whereas the latter bears resemblance to that of some species of *Trinacria*, especially the Claiborne species *T. pectuncularis* (Lea), through which the two genera may be connected. The ligament pattern of *T. perplana* also approaches that of typical *Halonanus*.

Halonanus differs from both *Trinacria* and *H.* (*Trinacriella*) in being definitely noetiform with a well developed cardinal area, although *H. decisa* (Conrad) (not figd.) appears to be intermediate between the typical form and *Trinacriella perplana*. *Halonanus* differs from the Noetinae in that its sculpture consists of only one set of ribs whereas the Noetinae are characterized by both primary and secondary ribs. Its ligament differs from that of *Noetia* in that in that genus there is an initial vertical element beginning directly beneath the umbo whereas in *Halonanus pulchra* there is an initial anterior diagonal groove which later develops into a vertically striated ligament. This condition has been observed nowhere else among the prionodont bivalves and is accounted for by the fact that the cardinal area of *Halonanus* is a secondary structure analogous to the primary cardinal area of *Linter*, the initial anterior diagonal ligament groove being a remnant of the anteriorly directed ligamental pit observed in *Trinacriella* and still well developed in *Halonanus decisa*. The ligament material is usually lost in specimens of *Trinacriella* and *Halonanus decisa* but a few specimens seen by the writer retain enough to show that the ligament contained vertical elements, even in the forms with more oblique pits. The secondary cardinal area of *Halonanus, sensu stricto*, is foreshadowed in the incipient cardinal area observed in some species of *Trinacriella*, particularly *T. perplana*.

CLASSIFICATION[2]

A partial classification of arcid Pelecypoda to include the subfamily Trinacriinae follows. This arrangement is based primarily on ligament structure but is correlated with dentition, orientation, sculpture, and other shell characters.

Order FILIBRANCHIA Pelseneer
Suborder PRIONODONTA MacNeil
Superfamilies CYRTODONTACEA, PARALLELODONTACEA, GLYCYMERACEA, ARCACEA
Superfamily GLYCYMERACEA MacNeil
Families GLYCYMERIDAE, CUCULLAEIDAE, NAVICULIDAE, LIMOPSIDAE, NOETIDAE

The superfamily Glycymeracea exhibits much less stability in ligament structure than the Parallelodontacea and Arcacea, and most of the aberrant types of ligaments are found here. It is interesting to note that all

[2] This classification is based on *Arca antiquata* as type of *Arca*. If the Commission should accept a recommendation before it at the present time to regard *Arca noae* as type, the following changes would become necessary: *Glycymeracea* would become *Arcacea; Arcacea* would become *Anadaracea;* and *Naviculidae* would become *Arcidae*.

opisthogyrate shells and all shells bearing a flange on the muscle scars fall in this superfamily.

Family NOETIDAE MacNeil

Subfamilies STRIARCINAE, TRINACRIINAE, NOETINAE

The family Noetidae includes all of the forms having vertical ligament elements.

Subfamily TRINACRIINAE MacNeil

This subfamily includes the three genera, *Linter* Stephenson, *Trinacria* Mayer, and *Halonanus* Stewart, and the subgenus *Trinacriella* MacNeil (under *Halonanus*).

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PALEOBOTANY.—*On the presence of the fern* Weichselia *in Colombia, South America.*[1] EDWARD W. BERRY, Johns Hopkins University.

Some months ago I received from Phillip L. Merritt, under the label of the Ministerio de Industrias y Trabajo, Bogota, Colombia, a package of fossil plants. These were collected near Mutiscua, which is between 10 and 11 miles slightly south of west of Pamplona in the northern part of the Department of Santander, and is shown on Hettner's map of the Cordillera of Bogotá.[2]

This material is of considerable interest and comprises 6 specimens which are covered with the impressions of the rachis and fronds of the fern known as *Weichselia*, which was almost world-wide in its distribution during the Mesozoic. The matrix is a rather soft, grayish mudstone, very similar to the shales on the Island of San Lorenzo, off the port of Callao, Peru, which are also packed with *Weichselia*, the only apparent lithologic difference being that the shales from Peru are slightly lighter in color.

The Colombian matrix has not been studied petrographically, but from its somewhat soapy feel, and its general similarity to that containing the Peruvian fossils, I regard it as probably representing a carbonaceous pyritiferous mudstone in which, because of tectonic

[1] Received August 23, 1937.
[2] HETTNER, ALFRED. *Die Kordillere von Bogotá.* Petermann's Mitt. Ergänzung Bd. 22, No. 104, 1891.

movements and circulating waters, the carbon and the sulfide were oxidized.

The plant impressions are typical of *Weichselia*, the larger frond fragments showing a stipe of about 3.5 millimeters diameter, and elongated parallel pinnae of lengths up to 10 or 11 centimeters, with the characteristic netted venation of the pinnules frequently in excellent preservation. Associated with the frond fragments are impressions of the sort that have often been interpreted as stems of *Equisetites*, as by Neumann, Schlagintweit, and others, which Zeiller considered, in the case of the Peruvian material, as the larger stems or petioles of *Weichselia*. Impressions of this sort, indistinguishable from the Peruvian material, are associated with the frond fragments in the present collection in lengths of about 11 centimeters, and with diameters of 2.5 to 3 centimeters.

The impression material of this frond genus, first described as a species of *Pecopteris* by Stokes & Webb in 1824, and named by Stiehler in 1857, is rather readily recognizable, and has been discovered in many parts of the world. It has been discussed by many authors, the bibliography amounting to upwards of fifty titles. In the latest discussion, that by Edwards in 1933, a rather good case is made out for correlating the impressions known as *Weichselia* with the structural material of stems, or more probably petioles, which have been described under the name of *Paradoxopteris*.[3] Despite all the available evidence and this correlation, the botanical affinity of *Weichselia* is not settled beyond a strong presumption that it is to be found in the family Marattiaceae, or in an allied and wholly extinct group.

A number of different species of *Weichselia* have been proposed. In describing the Mesozoic flora of Peru I followed Zeiller in using the specific designation *Weichselia peruvianum*,[4] which was based in the first instance on the impressions of large petioles which Neumann had mistakenly described as *Equisetites peruanus*. Although I saw no fertile specimens from Peruvian localities such as Zeiller thought he had, I considered that the reflexed basal pinnules might serve to differentiate the Peruvian from the European material. Edwards has shown, however, that this feature occurs also in some specimens of the European genotype *Weichselia reticulata*.

In spite of the lack of definite distinguishable characters I find it

[3] EDWARDS, W. N. *On the Cretaceous fern* Paradoxopteris *and its connection with* Weichselia. Annals of Botany 47: 317–341. 1933.

[4] BERRY, E. W. Johns Hopkins Studies in Geology 4: 52–55. 1922.

hard to believe that a single botanical species ranged over five continents—Europe, Asia, Africa, North and South America—and from at least the dawn of the Lower Cretaceous[5] to the Cenomanian stage of the Upper Cretaceous. Peruvian material was recorded in 1922 from ten different localities, and subsequently in the collections made by the Ellsworth Expedition from the coal measures of Huallanca in the Department of Ancachs, this species was found to be exceedingly abundant.

I may add that the North American occurrence of *Weichselia* in the Black Hills, about which I expressed some doubt in 1922, is perfectly authentic. I have since had a large amount of typical but very fragmentary material from that region.

Karsten, years ago, collected *Weichselia* at Santa Maria in northeastern Venezuela. This find was discussed by Schlagintweit[6] who concluded that its age was Neocomian. From Santa Maria through Mutiscua via the Andean geosyncline to the southernmost of the abundant Peruvian occurrences is a distance of about 2,500 miles. Occurrences of this species in Texas and in the Black Hills region of South Dakota carry its range northward to 44° north latitude, so that its known north-south range in the western hemisphere covers about 55° of latitude.

Regarding the exact age of the new material from Colombia no conclusion based upon paleobotanical evidence is possible. The European type is more common at Neocomian and Barremian horizons than later in the Cretaceous, but according to Edwards it ranges up through the Aptian to the Albian (upper Greensand) in England. In eastern Asia an Aptian age is supposed, and some of the north African occurrences have been regarded as Cenomanian. The Black Hills occurrences in North America are associated with a dicotyledonous flora and have been regarded as of Albian age. All that can be said of the age of the Mutiscua specimens is that they are probably Lower Cretaceous, but whether early or late in that period can not be determined, although, if the Peruvian occurrences have any weight, which is by no means certain, the balance of evidence would point to an earlier rather than a later Lower Cretaceous age.

Schuchert's map of the early Lower Cretaceous in the Caribbean and northern South America shows no seaway on the site of the

[5] The horizon of the Peruvian material in the Department of Lima has been incorrectly termed Wealden. It is considered by Peruvian geologists to be Neocomian, but it may well be as old as Portlandian. Probably Tithonian would be the proper designation.

[6] SCHLAGINTWEIT, O. Centralblatt f. Min. Geol. & Pal. 19(20): 315–319. 1919.

Venezuelan Andes, such a seaway first appearing on his map of the early Middle Cretaceous, whatever that may mean.[7] It is, of course, impossible to criticize such generalized maps covering such synthetic geologic time, but it is certainly a fact that Lower Cretaceous is present throughout the extent of the Venezuelan Andes from Colombia eastward to Trinidad.

ZOOLOGY.—*The Nearctic spiders of the family Heteropodidae.*[1] IRVING FOX, Iowa State College, Ames, Iowa. (Communicated by C. F. W. Muesebeck.)

The spiders of the group under discussion are generally held to comprise a distinct family having affinities with the Thomisidae and the Clubionidae; from the former they are distinguished particularly by the possession of teeth on the cheliceral margins and from the latter chiefly by the laterigrade legs and the more or less distinct membranes at the apices of the metatarsi. They are further characterized by the possession of a carapace which is as wide as long or slightly longer than wide, and by the scopulate tarsi which are armed with two claws. The eyes are eight in number and arranged in two transverse rows of four each.

The conception that these characters are of sufficient importance to warrant the maintenance of a distinct family is generally subscribed to by modern arachnologists, but there yet exists some disagreement concerning the proper family denomination. Two names have been commonly used, Heteropodidae Thorell and Sparassidae Simon; the former name appears to be the correct one. Thorell in 1873 suggested that *Heteropoda* and related genera be separated from the Thomisidae and combined into a new family, Heteropodidae.[2] In 1874 Simon revised the European species of this group under the family name Sparassidae,[3] and this and subsequent revisions had the effect of making Sparassidae the more extensively used name. On the basis of priority, however, Heteropodidae is the correct family name and Sparassidae is its synonym.

There is evident considerable confusion among authors concerning the proper usage of the names, *Sparassus*, *Olios*, and *Eusparassus*. The genus *Sparassus* was erected by Walckenaer in 1805,[4] and *S.*

[7] SCHUCHERT, CHARLES. *Historical geology of the Antillean-Caribbean region*, maps 4 and 5. 1935.

[1] Received August 18, 1937.

[2] *Remarks on the Synonyms of European Spiders*, Upsala, p. 606, 1870–1873.

[3] Ann. Soc. Ent. France 4: 243. 1874.

[4] *Tableau des Aranéides*, p. 40, 1805.

argelasius Walck. was subsequently designated as type by Thorell.[5] *S. argelasius* was re-described by Walckenaer in 1806,[6] by Latreille (under *Micrommata*) in 1818,[7] and again by Walckenaer in 1837.[8] Simon considered *S. argelasius* Walck. 1805 to be a *nomen nudum* and accepted *M. argelasius* Latreille 1818 as the earliest available name.[9] At the same time he decided that *M. argelasius* Latreille represented a group distinct from any previously described and made it the type of his new genus *Eusparassus*. Since publication of these views Simon's arrangement has been generally accepted, and *Eusparassus* has been considered a good genus, while *Sparassus* has been completely ignored.

Walckenaer's original description of 1805, while not detailed enough to permit recognition of the species, is sufficient to constitute a valid description, hence *S. argelasius* Walck. 1805 can not correctly be regarded as a *nomen nudum*, but must be considered a valid name. Latreille in his description of 1818 indicated conclusively that he was re-describing Walckenaer's species rather than describing a new one of his own, and further states that the species was recognized by Walckenaer as his *argelasius*. If the species that Latreille described in 1818 was different from the one described in 1805 by Walckenaer, as Simon apparently believed, the later name rests upon an error of identification and is invalid under Article 31 of the International Rules of Zoological Nomenclature. Since Latreille expressly states that Walckenaer recognized the species as the one he himself had described, there seems to be little reason to assume that Walckenaer's descriptions of 1805, 1806, and 1837, and Latreille's of 1818 do not refer to the same species. From this discussion it is apparent that the genus *Sparassus* Walck. is available and has as a synonym *Eusparassus* Simon; its type is *Sparassus argelasius* Walck., which name is to be used for the not uncommon European species now known as *Eusparassus argelasius* (Latreille).

The genus *Olios*, as it was originally described by Walckenaer in 1837 included an extremely heterogeneous assemblage of several genera. In 1880 Simon restricted it to the species congeneric with *O. spongitarsus* (Dufour) which he selected as the type.[10] He also indicated that *Sparassus argelasius* Walckenaer 1805 was the same as

[5] Nova acta. Reg. Soc. Sc. Upsaliae 7: 176. 1869–1870.
[6] *Histoire Naturelle des Araneides*, facic. 4: fig. 2. 1806.
[7] *Nouveau Dictionnaire d'Histoire Naturelle* 20: 516. 1818.
[8] *Histoire Naturelle des Insectes Apteres* 1: 584. 1837.
[9] *Histoire Naturelle des Araignees* 2: 1020. 1903.
[10] Act. Soc. Linn. Bordeaux 34: 297. 1880.

Dufour's species, yet he retained the later name. Subsequent authors were divided in their usage of the names *Olios* and *Sparassus*, some considering *Olios* a good genus, while others reasoned that since *O. spongitarsis* (Dufour), the type of *Olios*, was a synonym of *S. argelasius* Walck., the type of *Sparassus*, then *Olios* was a synonym of *Sparassus*.[11] However, Simon in 1903 stated that the previous synonymization of *O. spongitarsis* (Dufour) with *S. argelasius* Walck. was entirely gratuitous, as Walckenaer's original description was too brief to permit identification. On this account *Olios* is, in the present paper, regarded as the proper name for the species related to *spongitarsus* Dufour, while *Sparassus* is applied to the *argelasius* Walckenaer group.

The following pages are concerned with only the nearctic species of Heteropodidae; three new species and a new genus are described, and keys to the nearctic genera and species are given. The family is represented in the United States by three genera of which two, *Tentabunda* and *Heteropoda*, contain but one species, while the third, *Olios*, comprises six species.

I wish to express my appreciation to the authorities of the United States National Museum for the courtesy shown me while studying the collections in their charge. I am deeply obliged to Miss Elizabeth B. Bryant of the Museum of Comparative Zoology, to Dr. W. J. Gertsch, and Mr. H. K. Wallace of the American Museum of Natural History, and to Professor R. V. Chamberlin of the University of Utah for their generosity in lending material for study.

KEY TO THE NEARCTIC GENERA OF SPARASSIDAE

1. Spinnerets set upon a distinct basal segment..... *Tentabunda*
   Spinnerets normal, not set upon a distinct basal segment.....2
2. Anterior median eyes as large as or larger than the anterior lateral. Clypeus much lower than the diameter of an anterior median eye.. ..... *Olios*
   Anterior median eyes smaller than the anterior lateral. Clypeus higher than the diameter of an anterior median eye..... *Heteropoda*

TENTABUNDA, n. gen.

A genus in the subfamily Sparianthidinae. Cephalothorax robust, longer than wide. Eyes in two rows, with the anterior row straight or slightly procurved, the posterior row very procurved and broader than the anterior. Anterior median eyes slightly larger than the anterior lateral; posterior eyes subequal or with the posterior lateral eyes slightly larger than the posterior median. Median ocular quadrangle wider than long. Clypeus equal in height

[11] CAMBRIDGE, F. Biologia Centrali-Americana 2: 122. 1905.

to at least more than half the diameter of an anterior median eye. Lower cheliceral margin armed with six or seven small denticles, upper margin armed with three or four robust teeth. Anterior tibiae provided with 2-2-1 or 2-2-2 spines below; anterior metatarsi provided with one pair of spines below. Spinnerets six in number, set upon a distinct common basal segment.

Genotype.—*Pseudosparianthis cubana* Banks, 1909, known from Cuba and Florida.

Tentabunda cubana (Banks), n. comb. Figs. 5 and 11

Pseudosparianthis cubana Banks. Second Rep. Centr. Exper. Sta. Cuba, p. 165, pl. 45, fig. 4, 1909.

Pseudosparianthis cubana Bryant, Bull. Mus. Comp. Zoo. Cambridge, 74:192. 1933.

Female.—Total length, 10.69 mm. Carapace, 5.45 mm long, 3.86 mm at the widest place, 2.77 mm wide in front. Abdomen, 5.25 mm long, 2.97 mm wide. Carapace uniform reddish brown above without distinct markings, clothed with sparse pubescence. Sides concolorous with the dorsum, lacking distinct submarginal stripes. Chelicerae dark brown, much darker than the carapace. Sternum and coxae light yellowish brown, labium and endites reddish with white distal patches. Legs clear light yellow below and reddish above, without annulations. Dorsum of the abdomen with a grayish ground color upon which is a dark pattern consisting of a series of six or seven chevrons continuing to the spinnerets. Venter much lighter than the sides being light gray with sparse dark punctations. Spinnerets six in number, set upon a distinct common basal segment.

Anterior row of eyes slightly procurved, narrower than the very procurved posterior row (17/21). Anterior median eyes slightly closer to each other than to the anterior lateral and somewhat larger than the latter. Eyes of the posterior row subequal and equidistant, separated by more than two diameters. Median ocular quadrangle wider than long (18/15), narrower in front than behind (16/18), the posterior eyes about four-fifths as large as the anterior. Clypeus equal in height to about four-fifths the diameter of an anterior median eye. Chelicerae, 2.07 mm in length, lower cheliceral margin armed with seven small denticles, upper margin armed with four robust teeth. Tibiae I and II with 2-2-1 spines below, metatarsi I and II armed with one pair of spines below. Tibia and patella I, 6.24 mm long (tibia alone, 3.96 mm); tibia and patella IV, 5.25 mm long (tibia alone, 3.47 mm).

Epigynum wider than long (25/20), anteriorly provided with a wide atrium from which a distinct median suture extends posteriorly dividing the caudal portion of the epigynal plate into two equal halves. For further details regarding the structure of the epigynum see Fig. 5.

Described from a female specimen collected by T. H. Hubbell fourteen miles west of Palm Beach, Florida, October 29, 1934 and in the possession of the American Museum of Natural History.

Male.—Total length, 7.00 mm. Carapace, 3.56 mm. long, 3.27 mm at the widest place, 1.68 mm wide in front. Abdomen, 3.56 mm long, 2.48 mm wide. Carapace lighter than in the female, being yellowish rather than reddish and having a sparser pubescence. Chelicerae light yellowish brown, concolorous with the carapace. Sternum, coxae, labium, and endites whitish without distinct markings. Legs clear, concolorous with the sternum below, above yellowish and concolorous with the carapace. Dorsum of the abdomen as in the female, but in general somewhat lighter.

Anterior row of eyes slightly procurved, narrower than the very pro

curved posterior row (12/14). Eyes of the anterior row subequidistant with the anterior median slightly larger than the anterior lateral. Eyes of the posterior row subequal and equidistant, separated by about one and one-half diameters. Median ocular quadrangle wider than long (14/12.5), narrower in front than behind (12/14), the posterior eyes about four-fifths as large as the anterior. Clypeus equal in height to about four-fifths the diameter of an anterior median eye. Chelicerae, 1.19 mm long; lower cheliceral margin armed with seven small denticles, upper margin armed with four robust teeth. Tibiae I and II with 2-2-2 spines below, metatarsi I and II with one pair of spines below, and unlike the female with a basal and submedian lateral spine on each side. Tibia and patella I, 5.35 mm long (tibia alone, 3.86 mm); tibia and patella IV, 4.75 mm long (tibia alone, 3.27 mm).

Tibia of the palpus wider than long (22/15), expanded retrolaterad and more or less triangular in shape, tribranchiate with the tarsus articulated to the prolateral branch. For further details regarding the structure of the palpal organ see Fig. 11.

Described from a male specimen collected by M. Broyles at Coronado Beach, Volusia Co., Florida in August, 1935 and in the possession of the American Museum of Natural History.

The genus *Tentabunda* according to the present interpretation includes also the species described as *Pseudosparianthis variabilis* Cambridge,[12] known from Mexico, and *Pseudosparianthis antiguensis* Bryant,[13] known from the West Indies. The members of *Pseudosparianthis* are distinct from those of *Tentabunda* particularly in that the anterior metatarsi are armed with two pairs of spines rather than with one pair. The genus *Pseudosparianthis* is not known to occur in the nearctic region.

Olios Walckenaer

Ins. apteres, 1: 563, 1837. Genotype: *Micrommata spongitarsis* Dufour.

Cephalothorax robust, not at all or but slightly longer than wide. Eyes in two rows, each of which may be procurved, straight, or less commonly recurved, with the anterior row narrower than the posterior. Eyes of the anterior row subequal or with the anterior median eyes slightly larger than the anterior lateral and closer to the latter than to each other. Eyes of the posterior row subequidistant and subequal or with the posterior median eyes slightly smaller than the posterior lateral. Clypeus much narrower than the diameter of the anterior median eyes. Lower cheliceral margin armed with three or four teeth. Anterior tibae normally armed with 2-2 spines below.

KEY TO THE NEARCTIC SPECIES OF OLIOS[14]

1. Chelicerae yellowish or reddish brown, not contrasting strongly with the dorsum of the carapace 2
   Chelicerae jet black, contrasting strongly with the dorsum of the carapace ..... *O. fasciculatus*
2. Males 3
   Females 5

[12] Cambridge, F. Biol. Centr. Amer. II: 119, pl. VIII, fig. 21. 1900.
[13] Bryant, E. B. Univ. Iowa Studies X: 13, pl. I, fig. 4. 1923.
[14] It has not been possible to place *Olios franklinus* Walckenaer because of the inadequate original description

3. Tibial apophysis divided into two distinct branches which are not longer than the tibia....4
   Tibial apophysis not divided into two distinct branches, and as long as the tibia....*O. schistus* (Fig. 10)
4. Distal spinose process of the tibia about two and one-half times as long as either of the branches of the tibial apophysis....*O. bibranchiatus* (Fig. 8)
   Distal spinose process of the tibia not longer than the branches of the tibial apophysis....*O. abnormis* (Fig. 2)
5. Epigynal atrium much wider than long....*O. bibranchiatus* (Fig. 6)
   Epigynal atrium as long as or longer than wide....6
6. Epigynal atrium much longer than wide....*O. mohavensis* (Fig. 4)
   Epigynal atrium about as wide as long....7
7. Anterior border of the epigynal atrium with a large posteriorly directed lobe....*O. albinus* (Fig. 3)
   Anterior border of the epigynal atrium without such a lobe..*O. schistus* (Fig. 7)

Olios fasciculatus Simon Figs. 1 and 9

Olios fasciculatus Simon. Act. Soc. Linn. Bordeaux **34**: 307. 1880.
Olios giganteus Keyserling, Verh. Zool. Bot. Ges. Wien **33**: 681, pl. XXI, fig. 28, 1883.
Olios concolor Keyserling, Verh. Zool. Bot. Ges. Wien **33**: 682, pl. XXI, fig. 29, 1883.
Olios fasciculatus Banks, Proc. U. S. Nat. Mus. **23**: 585. 1901.
Olios pragmaticus Chamberlin, Proc. California Acad. Sci. **12**: 659, fig.102. 1924.

Female.—Total length, 19.00 mm. Carapace, 6.93 mm long, 7.43 mm at the widest place, 4.65 mm wide in front. Abdomen 11.78 mm long, 9.00 mm wide. Carapace irregular light reddish brown above, pars cephalica with a median longitudinal light narrow band extending from a short distance anterior to the thoracic groove to a point midway between the posterior median eyes; pars thoracica provided with a deep groove from which light bands radiate. Sides of the carapace with light submarginal bands. Chelicerae black, contrasting strongly with the carapace. Sternum and coxae light yellowish brown; labium and endites somewhat darker bearing white distal patches. Legs concolorous with the sternum being light yellowish brown without distinct annulations. Dorsum of the abdomen lighter than the carapace, grayish with brown streaks and spots, provided with a basal white mark outlined with dark which extends caudad in the form of a dark line reaching to the posterior termination of the abdomen. Venter lighter than the sides with indications of two median parallel dark lines.

Anterior row of eyes slightly recurved and narrower than the procurved posterior row (22/27). Eyes of the anterior row subequal, the anterior median eyes closer to the anterior level than to each other, being separated from each other by more than a diameter, from the anterior lateral by two-thirds of a diameter. Eyes of the posterior row subequidistant, separated by more than twice the diameter of a posterior median eye, the posterior median eyes two-thirds as large as the posterior lateral. Median ocular quadrangle slightly wider than long, slightly wider in front than behind, the posterior eyes about two-thirds as large as the anterior. Clypeus equal in height to about two-thirds the diameter of an anterior median eye. Chelicerae, 3.56 mm in length; lower cheliceral margin armed with four

teeth of which the basal two are small and weak while the distal two are large and robust, upper margin armed with two small teeth, one large and one small. Tibiae I and II with 2-2 spines below. Tibia and patella I, 11.39 mm long (tibia alone, 7.43 mm); tibia and patella IV, 9.41 mm (tibia alone, 6.24 mm).

Epigynum very small, about as long as wide with the atrium about as wide in front as behind and provided with an incomplete median septum which extends barely half-way down its length. Side pieces lightly or not at all chitinized. For further details regarding the structure of the epigynum see Fig. 1.

Described from a female specimen collected at Oracle, Arizona, July, 1898 by E. A. Schwartz and in the possession of the United States National Museum.

Male.—Total length, 12.00 mm. Carapace, 6.44 mm long, 6.04 mm at the widest place, 3.56 mm wide in front. Abdomen, 5.94 mm long, 3.47 mm wide. Dorsum of the carapace somewhat darker than in the female, but with the same markings. Chelicerae dark brown to black. Sternum orange brown lighter than the legs which are dark brown. Dorsum, sides, and venter of the abdomen colored as in the female.

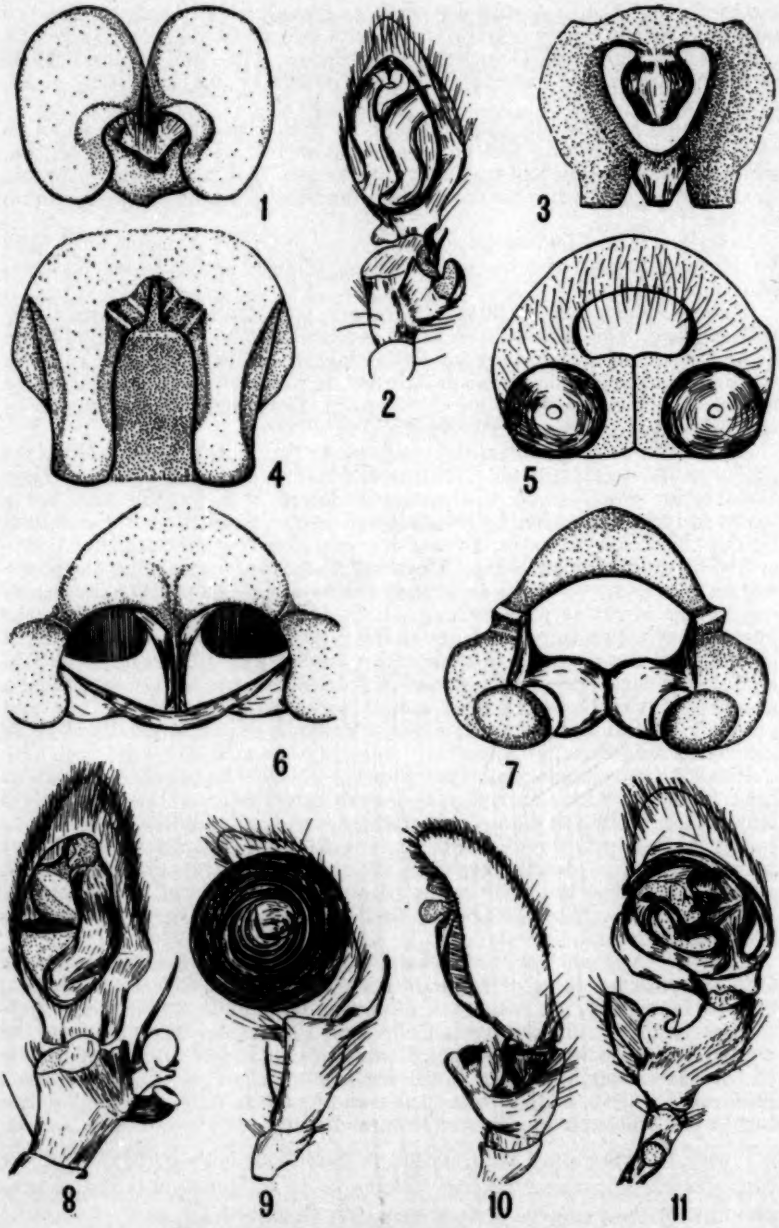
Anterior row of eyes slightly recurved or straight, narrower than the procurved posterior row (22/27). Anterior median eyes slightly larger than the anterior lateral, closer to the anterior lateral than to each other being removed from each other by one-half a diameter, from the anterior lateral by one-third of a diameter. Eyes of the posterior row subequidistant, separated by more than twice the diameter of a posterior median eye, the posterior median eyes two-thirds as large as the posterior lateral. Median ocular quadrangle about as wide as long, about as wide in front as behind, the posterior eyes two-thirds as large as the anterior. Clypeus equal in height to one-third the diameter of an anterior median eye. Chelicerae, 2.38 mm long; lower cheliceral margin armed with three robust teeth, upper margin armed with two teeth. Tibiae I and II with 2-2 spines below. Tibia and patella I, 11.48 mm long, (tibia alone, 7.92 mm); tibia and patella IV, 9.90 mm long (tibia alone, 7.13 mm).

Patella of the palpus longer than wide (11/8), tibia longer than the patella (15/11), armed with a subapical apophysis extending retrolaterad which is longer than the width of the tibia and more or less hook-like distally. The tarsus is wide and provided with an embolus that completes at least five turns. For further details regarding the structure of the palpus see Fig. 9.

Described from the holotype of Keyserling's *O. concolor*, collected at Punta del Aqua, New Mexico and in the possession of the United States National Museum.

Records.—Arizona: Fort Yuma, immature female; Madera Canyon, Santa Rita Mountains, June, 1898, male (E. A. Schwartz, collector). Mexico: Sonora, female (H. M. Stanley, Collector); Guanajuato, two females, September 1, 1886 (Alfred Duges, Collector); Guaymas, female, (all in the United States National Museum). Utah: Zion Park, 1937, male and female (A. M. Woodbury, Collector) in the Collection of Prof. R. V. Chamberlin.; St. George, July 6, 1931, several males and females (W. J. Gertsch, Collector) in the American Museum of Natural History.

I wish to express my appreciation to Miss Elizabeth B. Bryant of the Museum of Comparative Zoology for comparing specimens of *O. fasciculatus* Simon with the paratype of *O. pragmaticus* Chamberlin.



Figs. 1–11. (See opposite page for explanation.)

Olios schistus Chamberlin Figs. 7 and 10

Olios schistus Chamberlin, Pomona College Jour. Ent. and Zoo., 12:10, pl. 4, figs. 2 and 3, 1920 (Advance Reprint in 1919).

Female.—Total length, 12.5 mm. Carapace, 4.95 mm long, 4.55 mm at the widest place, 3.17 mm in front. Abdomen, 7.5 mm long, 5.64 mm wide. Carapace irregular dark reddish brown above, the pars cephalica noticeably lighter than the pars thoracica; dorsal groove distinct, from it light bands radiate to the sides which are provided with light sub-marginal bands. Chelicerae reddish brown more or less concolorous with the pars cephalica. Sternum orange brown, lighter than the coxae which are dark brown; labium and endites reddish bearing white distal patches. Legs reddish with numerous small punctations on all the joints, the tibiae with indications of a narrow dark annulus basally. Dorsum of the abdomen irregular-reddish brown streaked with light and dark, and in this specimen, without distinct markings. Sides densely provided with dark spots and streaks; venter somewhat lighter, with a broad median dark band extending from the epigynum to the spinnerets.

Anterior row of eyes slightly recurved, narrower than the slightly procurved posterior row (19/23). Eyes of the anterior row subequal, the anterior median eyes closer to the anterior lateral than to each other, being separated from each other by more than a diameter, from the anterior lateral eyes by five-sevenths of a diameter. Eyes of the posterior row subequal and subequidistant, separated from each other by about two and one-half diameters. Median ocular quadrangle about as long as wide, slightly wider behind than in front, the posterior eyes about five-sevenths as large as the anterior. Clypeus equal in height to slightly more than one-half the diameter of an anterior median eye. Chelicerae, 2.08 mm long; lower cheliceral margin armed with four teeth of which the basal two are small and weak, while the distal two are large and robust; upper margin armed with two teeth, one large and one small. Tibiae I and II with 2-2 spines below. Tibia and patella I, 7.23 mm long (tibia alone, 4.74 mm); tibia and patella IV, 5.64 mm long (tibia alone, 3.56 mm).

Epigynum consisting of a more or less oval atrium flanked by heavily chitinized side pieces. For further details regarding the structure of the epigynum see Fig. 7.

Described from a female specimen collected at San Diego, California and in United States National Museum. A female from San Jacinto is also in that institution.

Male.—Total length, 8.10 mm. Carapace, 4.00 mm long, 4.16 mm at the widest place, 2.48 mm wide in front. Abdomen, 4.85 mm long, 3.46 mm wide. Carapace light brown above with distinct reddish punctations. Chelicerae concolorous with the carapace, bearing reddish punctations. Sternum and coxae yellowish brown with minute punctations; labium and endites reddish with distal white patches. Legs light brown, densely provided with dark punctations, tibiae with an annulus basally. Dorsum of the abdomen

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Fig. 1.—*Olios fasciculatus* Simon, epigynum. Fig. 2.—*O. abnormis* Keyserling, male palpus, ventral view. Fig. 3.—*O. albinus*, n. sp., epigynum. Fig. 4.—*O. mohavensis*, n. sp., epigynum. Fig. 5.—*Tentabunda cubana* (Banks), epigynum. Fig. 6.—*Olios bibranchiatus*, n. sp., epigynum. Fig. 7.—*O. schistus* Chamberlin, epigynum. Fig. 8.—*O. bibranchiatus*, n. sp., male palpus, ventral view. Fig. 9.—*O. fasciculatus* Simon, male palpus, ventral view. Fig. 10.—*O. schistus* Chamberlin, male palpus, lateral view. Fig. 11.—*Tentabunda cubana* (Banks), male palpus, ventral view.

gray with dark brown maculations; the distinct design consists of a basal gray lanceolate mark outlined in dark which extends to the posterior termination of the abdomen in the form of an irregular dark band. Sides and venter streaked with reddish maculations.

Anterior row of eyes slightly recurved, narrower than the procurved posterior row (32/39). Eyes of the anterior row subequal, the anterior median eyes separated from each other by slightly more than a diameter, from the anterior lateral by about one-third of a diameter. Eyes of the posterior row subequal and equidistant, separated by more than two diameters. Median ocular quadrangle about as long as wide, slightly wider behind than in front, the posterior eyes about two-thirds as large as the anterior. Clypeus equal in height to about one-half the diameter of an anterior median eye. Chelicerae, 1.68 mm long; lower cheliceral margin armed with four teeth of which the basal two are small and weak, while the others are large and robust; upper cheliceral margin armed with two teeth, one small and one large. Tibiae I and II with 2-2 spines below. Tibia and patella I, 7.23 mm long (tibia alone, 5.15 mm); tibia and patella IV, 6.53 mm long (tibia alone, 4.46 mm).

Patella of the palpus about as long as wide, tibia more than twice as long as the patella, with a broad distally expanded apophysis which is as long as the joint, and two distal processes of which one is longer than the other. For further details regarding the structure of the palpal organ see Fig. 10.

Described from a male specimen collected at Claremont, California and in the Collection of Prof. R. V. Chamberlin.

This species is most closely related to *O. peninsulans* Banks, known from Baja California, and is distinguished from the latter primarily by the character of the tibial apophysis of the male palpus which is distally truncate and bifid instead of sloping to a point. In general structure and appearance it resembles *O. abnormis* Keyserling from which it may also be differentiated by the structure of the tibial apophysis.

Olios bibranchiatus, n. sp. Figs. 6 and 8

Sparassus minax Banks, Proc. U. S. Nat. Mus. **23**:585. 1901. (Not *Olios minax* (Cambridge))

Male.—Total length, 11.00 mm. Carapace, 5.25 mm long, 4.95 mm at the widest place, 2.97 mm wide in front. Abdomen, 5.45 mm long, 3.96 mm wide. Dorsum of the carapace orange brown with lighter bars and streaks. Clypeus and chelicerae more or less concolorous with the carapace, the claws blackish. Sternum and coxae clear light brown, without dark markings; labium and endites somewhat darker, bearing white distal patches. Legs reddish brown with minute dark punctations but without annulations. Abdomen irregular brown and gray above, with evidences of dark chevrons posteriorly. Venter and sides lighter than the dorsum, clear yellowish without dark markings.

Anterior row of eyes slightly recurved, narrower than the procurved posterior row (17/21). Anterior median eyes slightly larger than the anterior lateral, separated from each other by about a diameter, somewhat closer to the anterior lateral than to each other. Eyes of the posterior row subequi-

distant and separated by about twice the diameter of a posterior median eye, the posterior lateral eyes somewhat larger than the posterior median. Median ocular quadrangle about as long as wide, wider behind than in front, the posterior eyes about five-sevenths as large as the anterior. Clypeus equal in height to about five-sevenths the diameter of an anterior median eye. Chelicerae, 2.18 mm long; lower cheliceral margin armed with four teeth of which the basal is small and weak while the distal three are large and robust; upper margin armed with two teeth, one large and one weak. Tibiae I and II with 2-2 spines below. Tibia and patella I, 10.30 mm long (tibia alone, 7.33 mm); tibia and patella IV, 8.81 mm long (tibia alone, 6.34 mm).

Patella of the palpus longer than wide, tibia slightly longer than the patella; tibial apophysis bibranchiate, the anterior branch with a conspicuous node distally, from the base of this branch a pointed process as long as the tibia itself extends anteriorly. For further details regarding the structure of the palpus see Fig. 8.

Female.—Total length, 14.85 mm. Carapace, 6.44 mm long, 5.74 mm at the widest place, 3.66 mm wide in front. Abdomen, 8.22 mm long, 5.00 mm wide. Carapace yellowish brown above without dark markings, clothed with a white pubescence. Clypeus and eye region concolorous with the dorsum; chelicerae dark brown, the claws blackish. Sternum and coxae yellowish brown without dark markings; labium and endites darker, with white distal patches. Legs concolorous with the dorsum of the carapace being clear light yellowish brown without annulations. Abdomen light brown, with indications of a basal dark median lanceolate mark; venter lighter than the dorsum, unmarked.

Anterior row of eyes recurved, narrower than the procurved posterior row (21/26). Eyes of the anterior row subequal, the anterior median eyes closer to the anterior lateral than to each other, being separated from each other by slightly more than a diameter, from the anterior lateral by five-eighths of a diameter. Eyes of the posterior row subequidistant, separated from each other by about twice the diameter of a posterior median eye, the posterior lateral eyes slightly larger than the posterior median. Median ocular area wider than long (23/18), somewhat wider behind than in front, the posterior eyes about five-eighths as large as the anterior. Clypeus equal in height to five-eighths the diameter of an anterior median eye. Chelicerae, 3.46 mm long; lower margin armed with four teeth, of which the basal is small while the distal three are large, upper margin armed with two teeth of which one is large and the other small. Tibiae I and II with 2-2 spines below. Tibia and patella I, 9.00 mm long (tibia alone, 5.94 mm); tibia and patella IV, 7.72 mm long (tibia alone, 5.25 mm).

The epigynum is subject to some variation; in some cases a distinct median inverse T-shaped septum is present (as in the allotype, Fig. 6), while in others the longitudinal bar of the septum is indistinct or lacking. Paratypic material in the American Museum of Natural History exhibits this difference, but the transverse bar of the septum is the same in each case.

Type locality.—Arizona: Male holotype from Madera Canyon, Santa Rita Mountains, May, 1898 (E. A. Schwartz, Collector), in the United States National Museum (U.S.N.M. Cat. No. 1274). Female allotype from Santa Fe, New Mexico, also in the United States National Museum. Two male paratypes and three female paratypes from Oro Blanco Mts., 12 miles from Nogales, Arizona, July, 1937, in the American Museum of Natural History.

Olios abnormis Keyserling Fig. 2

Olios abnormis Keyserling, Verh. Zool. Bot. Ges. Wien **33**: 679, Pl. XXI, Fig. 27. 1883.

Male.—Total length, 8.10 mm. Carapace, 4.36 mm long, 3.96 mm at the widest place, 2.28 mm wide in front. Abdomen, 3.96 mm long, 2.87 mm wide. Carapace light reddish brown above, with streaks of dark brown on the pars cephalica, sides without submarginal light bands. Clypeus, eye region, and chelicerae concolorous with the dorsum. Sternum yellowish, with minute reddish punctations; coxae and endites clear yellowish brown, without reddish markings, labium somewhat darker. Legs reddish brown with numerous minute punctations; tibia with a dark annulus at their proximal ends. Abdomen yellowish brown, provided with a distinct median design which consists of a basal lanceolate white mark outlined with reddish brown which extends to the posterior termination of the abdomen in the form of an irregular dark brown line. Sides and venter densely provided with reddish maculations.

Anterior and posterior eye rows slightly procurved, the former shorter than the latter (35/42). Anterior median eyes separated from each other by about a diameter, from the anterior lateral by about three-fifths of a diameter and larger than the latter (6/5). Eyes of the posterior row subequal and equidistant separated from each other by about two diameters. Median ocular quadrangle wider than long (17/15), about as wide in front as behind; the posterior eyes about five-sevenths as large as the anterior. Clypeus equal in height to about three-sevenths the diameter of an anterior median eye. Chelicerae, 1.68 mm long; lower cheliceral margin armed with four teeth of which the distal three are large and the basal is weak; upper margin armed with two teeth one large and the other small. Tibia I and II with 2-2 spines below. Tibia and patella I, 6.43 mm long (tibia alone, 4.36 mm); tibia and patella IV lacking in the specimen.

Patella of the palpus longer than wide (15/12), tibia about twice as long as the patella, with a thick retrolateral bibranchiate apophysis, about as long as the width of the joint, and two distal processes, one of which is spinose while the other is distinctly hook-like. For further details regarding the structure of the palpus see Fig. 2.

Described from a male specimen collected at Kits Peak, Rincon, Baboquivari Mountains, Arizona, July 31–Aug. 3, 1916, by F. E. Lutz and in the Collection of the American Museum of Natural History. A single male in poor condition from Los Angeles, California, is in the United States National Museum.

Olios mohavensis, n. sp. Fig. 4

Female.—Total length, 16.80 mm. Carapace, 6.83 mm long, 6.04 mm at the widest place, 4.06 mm wide in front. Abdomen, 9.91 mm long, 5.60 mm wide. Dorsum of the carapace muddy brown, the pars cephalica much lighter than the pars thoracica and provided anteriorly with two parallel lines which extend forward between the posterior median eyes. Clypeus and chelicerae concolorous with the pars cephalica, the claws blackish. Sternum and coxae light yellowish brown; labium and endites somewhat darker, bearing white distal patches. Legs uniform light yellowish brown without annulations. Abdomen orange brown above, provided with a dark basal lanceolate mark from whose sides project several dark lines; this mark is flanked on each side by a submedian and a subterminal punctation. Venter lighter than the sides, provided with two short dark lines.

Anterior and posterior rows of eyes slightly procurved, the former narrower than the latter (22/27). Eyes of the anterior row subequal, the anterior median eyes closer to the anterior lateral than to each other, being separated from each other by more than a diameter, from the anterior lateral by five-eighths of a diameter. Eyes of the posterior row subequidistant, separated by more than two times the diameter of a posterior median eye, the posterior lateral eyes somewhat larger than the posterior median. Median ocular quadrangle about as wide as long, as wide in front as behind; the posterior eyes about two-thirds as large as the anterior. Clypeus equal in height to about five-eighths the diameter of an anterior median eye. Chelicerae, 3.00 mm long; lower cheliceral margin armed with four teeth of which the basal is small and weak while the distal three are large and robust, upper margin armed with two teeth, one large and one small. Tibiae I and II with 2-2 spines below. Tibia and patella I, 10.49 mm long (tibia alone, 7.52 mm); tibia and patella IV, 9.41 mm long (tibia alone, 6.73 mm).

Epigynum about as long as wide, consisting of a deep chitinized atrium flanked by heavy side pieces. For further details regarding the structure of the epigynum see Fig. 4.

Type locality.—California: Female holotype from Mohave Desert (no further data) in the United States National Museum (U.S.N.M. Cat. No. 1273).

Olios albinus, n. sp. Fig. 3

Female.—Total length, 12.87 mm. Carapace, 4.95 mm long, 4.65 mm at the widest place, 3.17 mm wide in front. Abdomen, 7.43 mm. long, 5.94 mm wide. Dorsum of the carapace whitish, the pars cephalica outlined with minute punctations. Eye region, clypeus, and chelicerae tinged with orange, the claws of the chelicerae blackish. Sternum and coxae white, labium and endites light brown with whitish distal patches. Legs uniform white below, above whitish with sparse punctations except for the metatarsi and tarsi which are brown contrasting with the other joints. Dorsum of the abdomen whitish tinged with brown, a basal lanceolate mark is outlined by brown spots and continues posteriorly in the form of an irregular median longitudinal. band. Venter lighter than the dorsum and sides, being white and unmarked.

Anterior row of eyes straight, narrower than the slightly procurved posterior row (19/23). Anterior median eyes closer to the anterior lateral than to each other, separated from each other by about a diameter, from the anterior lateral eyes by about five-sevenths of a diameter and larger than the latter. Eyes of the posterior row subequal and equidistant, separated by about two diameters. Median ocular quadrangle wider than long (20/17), slightly wider behind than in front, the posterior eyes about five-sevenths as large as the anterior. Clypeus equal in height to about one-half the diameter of an anterior median eye. Chelicerae, 2.18 mm long; lower cheliceral margin armed with three teeth, upper margin armed with two. Tibiae I armed with 2-2 spines below; spination of the animal's left tibia II irregular, apparently involving 2-1r-2-1r spines below, spination of the right tibia normal, involving 2-2 spines below. Tibia and patella I, 7.13 mm long (tibia alone, 4.65 mm); tibia and patella IV, 5.45 mm long (tibia alone, 3.66 mm).

Epigynal area small, the atrium more or less heart shaped, provided with a lobe which extends caudally from the anterior border and divides the anterior three-fourths of the atrium into two parts. For further details regarding the structure of the epigynum see Fig. 3.

Type locality.—Arizona: Female holotype from Phoenix, May, 1935, in the Collection of Prof. R. V. Chamerlin.

HETEROPODA Latreille

Nouv. Dict. Hist. Nat., **XXIV**: 135. 1804. Genotype: *Aranea venatoria* Linnaeus.

Cephalothorax about as wide as long or slightly longer than wide. Eyes in two rows with the anterior row straight or procurved and narrower than the straight or slightly recurved posterior row. Anterior median eyes smaller than the anterior lateral and usually closer to the latter than to each other. Posterior median eyes usually smaller than the posterior lateral. Clypeus higher than the diameter of an anterior lateral eye. Lower cheliceral margin armed with four teeth, upper margin armed with two or three teeth. Anterior tibiae armed with 2-2-2-2 spines below.

Heteropoda venatoria (Linn.)

Aranea venatoria Linnaeus, Syst. Nat. 12th Ed. p. 1035, 1767.

This often-described cosmopolitan tropical species has long been known to occur in our Southwestern states and in Florida. Inasmuch as it has been considered by many authors and good descriptions and figures are generally available, it is not redescribed at this time.[15]

ENTOMOLOGY.—*The cinerosus group of the genus* Laevicephalus (*Homoptera: Cicadellidae*).[1]

P. W. OMAN, Bureau of Entomology and Plant Quarantine.

The six species treated in this paper form a remarkably homogeneous group on the basis of habitus, coloration, and certain structural details of the genitalia, and by these characters may be distinguished from other members of the genus *Laevicephalus*. The ground color of the head is pale cinereous to pale, sordid yellow; never green or greenish tinged. The crown has a pair of oblique fuscous or brown dashes at the apex and two pairs of similarly colored, irregularly quadrate spots on the disk. The facial sclerites are usually fuscous, the clypeus, at least laterally, is marked with transverse bars of brown or fuscous, and the thorax and abdomen are variously marked with fuscous.

The male valve is large and triangular, the plates broad and rather short and furnished laterally with a few spine-like setae. The distal portion of the style is definitely foot-shaped in outline and serrate on the posterior margin. The base of the aedeagus is furnished with a more or less flaring, submembranous portion for muscular attach-

[15] Excellent figures may be found in F. Cambridge's *Biologia Centrali-Americana*, II: 120, pl. VIII, figs. 22*a–c*, 23*a–f*. 1905. For the synonymy of this species see also Petrunkevitch's catalogue in Bull. Amer. Mus. Nat. Hist. **29**: 488. 1911.

[1] Received August 12, 1937.

ment. The pygofers of both sexes are densely set with numerous stout setae and the seventh sternite of the female has the posterior margin either incised or emarginate and bordered with fuscous or black medially.

With the exception of specimens from southern Utah and south central Washington, all the available distribution records for members of the cinerosus group are from California.

KEY TO THE SPECIES OF THE CINEROSUS GROUP

1 Posterior margin of seventh sternite of female broadly emarginate; male plates bluntly rounded distally ..... *incongruus*, n.sp.
Posterior margin of seventh sternite of female not broadly emarginate; male plates pointed distally 2
2(1) A rather short and robust species, fore wings not extending beyond tip of abdomen ..... *pacificus*, n.sp.
Elongate and slender species, fore wings extending beyond tip of abdomen 3
3(2) Male plates not contiguous for entire length, the tips diverging. Posterior margin of seventh sternite of female with two pairs of dentate projections, the inner pair nearly as large as the outer pair ..... *cinerosus* (Van D.)
Male plates contiguous for entire length. Posterior margin of seventh sternite of female either not quadridentate or, if so, with inner pair of projections much smaller than outer pair 4
4(3) Processes of aedeagus reduced to short, dentate projections. Posterior margin of seventh sternite of female triangularly produced and narrowly incised ..... *joaquinus*, n.sp.
Processes of aedeagus longer, not dentate. Posterior margin of seventh sternite of female not narrowly incised 5
5(4) Aedeagus with two pairs of pointed processes distally. Inner pair of dentate projections on posterior margin of seventh sternite of female rudimentary ..... *angelus*, n.sp.
Aedeagus with one pair of pointed processes distally. Inner pair of dentate projections on posterior margin of seventh sternite of female small but distinct ..... *siskiyou*, n.sp.

Laevicephalus incongruus, n. sp. Figs. 1, 7, 13

Larger and paler than *cinerosus*, with the male plates blunt and the posterior margin of the seventh sternite of the female broadly emarginate. Length of male 4–4.5 mm, of female 4.5–4.9 mm.

Ground color sordid yellowish white, oblique dashes on anterior margin of crown fuscous, marks on disk of crown pale brown, fuscous borders of cells of fore wing faint or absent, fore wings subhyaline.

Seventh sternite of female rather short, the median one-half of the posterior margin emarginate about one-third the distance to base. Male valve unusually large; plates short and blunt, not contiguous on median line.

Distal portion of aedeagus slender and strongly decurved, apex bifurcate. Basal portion of aedeagus unusually large and flaring. Style slender.

Holotype male, allotype female, and 85 paratypes, including specimens of both sexes, collected above Mint Canyon, Calif. June 8, 1935, by the writer

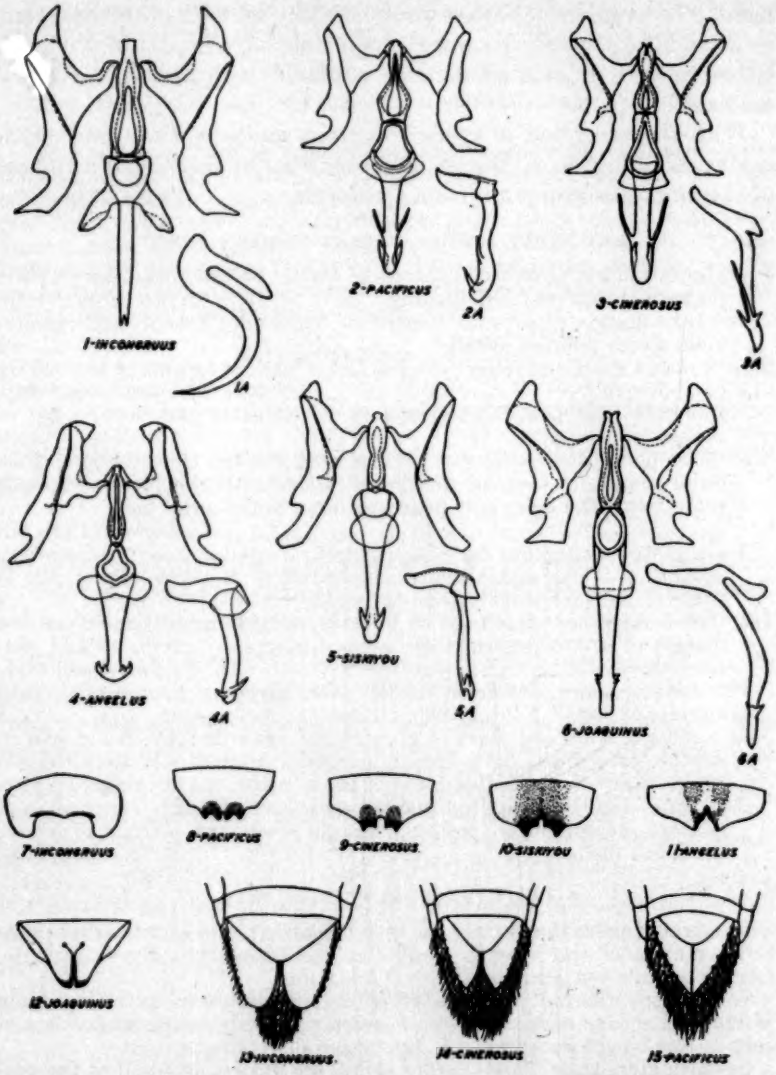

Fig. 1.—*Laevicephalus incongruus*, dorsal view of internal genital structures of male; 1A, lateral view of aedeagus. Fig. 2.—*L. pacificus*, dorsal view of internal genital structures of male; 2A, lateral view of aedeagus. Fig. 3.—*L. cinerosus*, dorsal view of internal genital structures of male; 3A, lateral view of aedeagus. Fig. 4.—*L. angelus*, dorsal view of internal genital structures of male; 4A, lateral view of aedeagus. Fig. 5.—*L. siskiyou*, dorsal view of internal genital structures of male; 5A, lateral view of aedeagus. Fig. 6.—*L. joaquinus*, dorsal view of internal genital structures of male;

and Mrs. Oman. Types in the collection of the United States National Museum (No. 52203). In addition to the type series, there are specimens at hand from Mint Canyon, Calif. (Oman), and Mt. Diablo, Calif. (Oman).

Laevicephalus cinerosus (Van Duzee) Figs. 3, 9, 14

Deltocephalus cinerosus Van Duzee, Trans. Amer. Ent. Soc. 19: 305, 1892.

Length 3.5–4 mm. Ground color pale, sordid yellow; markings varying from pale brown to fuscous. Marks on disk of crown faint, longitudinal lines on pronotum indistinct. Cells of fore wing bordered with fuscous, veins pale. Fore wings extending beyond tip of abdomen.

Seventh sternite of female short laterally, posterior margin with a small median emargination and on each side of this a pair of short, angled, dentate projections. Male plates rather short, diverging posteriorly, tips pointed.

Aedeagus rather stout, with three pairs of pointed projections arising from near tip and extending basad and slightly outward as follows: An elongate, slender pair laterally, a short, slender pair latero-ventrally, and a short pair latero-dorsally. Style relatively slender.

Originally described from 1 male and 4 females collected in California by Coquillett. The male of this series, which is in the collection of Iowa State College, Ames, Iowa, is here designated lectotype. I am indebted to Mr. L. D. Tuthill for drawings of the aedeagus of this specimen.

Material from the following California localities has been examined: Los Angeles County (Coquillett), Warner Springs (Oman), Cajon Pass (Oman), Del Mar (Oman), Newton (Oman), and Perris (Oman). Two females from southern Utah are referred here also.

Laevicephalus pacificus, n. sp. Figs. 2, 8, 15

Smaller and more robust than *cinerosus*, with the male plates contiguous for their entire length and the aedeagus with only two pairs of processes. Length of male 3–3.25 mm, of female 3.5–3.75 mm.

Ground color as in *cinerosus*, oblique dashes at apex of crown short, markings on disk of crown pale brown. Fore wings of male equalling abdomen in length, those of female shorter than abdomen, cells marked with fuscous especially around edges. Hind wings of both sexes much shortened.

Posterior margin of seventh sternite of female with a small median emargination, and a pair of blunt, dentate projections on each side of this. Male plates rather broad, contiguous on median line, and tapering abruptly to pointed apices.

Aedeagus rather stout, with two pairs of pointed processes as follows: A slender pair arising laterally on shaft before apex and extending laterad and basad, and a stout pair arising from a latero-ventral position near the apex and extending ventrad, basad, and slightly laterad. Style slender.

Holotype male, allotype female, and 17 male and 19 female paratypes

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6A, lateral view of aedeagus. Fig. 7.—*L. incongruus*, seventh sternite of female. Fig. 8.—*L. pacificus*, seventh sternite of female. Fig. 9.—*L. cinerosus*, seventh sternite of female. Fig. 10.—*L. siskiyou*, seventh sternite of female. Fig. 11.—*L. angelus*, seventh sternite of female. Fig. 12.—*L. joaquinus*, seventh sternite of female. Fig. 13.—*L. incongruus*, external genitalia of male. Fig. 14.—*L. cinerosus*, external genitalia of male. Fig. 15.—*L. pacificus*, external genitalia of male.

from Montara, Calif., June 13, 1935, collected by the writer and Mrs. Oman. Types in collection of the United States National Museum (No. 52204). In addition to the type series there are specimens at hand from San Francisco, Calif. (Oman).

Laevicephalus siskiyou, n. sp. Figs. 5, 10

Related to *pacificus* by the shape of the male plates, but less robust; similar to *cinerosus* in general form; markings darker than in either of those species. Length 3.6–4.2 mm.

Ground color as in *cinerosus*. Oblique fuscous dashes at apex of crown fused posteriorly with the anterior pair of marks on disk of crown. Posterior pair of marks on crown brown. Longitudinal stripes on pronotum distinct. Fore wings subhyaline, veins whitish cinereous, cells bordered with brown or fuscous.

Seventh sternite of female similar to that of *cinerosus*, but with median emargination smaller and inner pair of dentate projections shorter. Male plates as in *pacificus*, but shorter and more sharply pointed.

Aedeagus relatively slender and elongate, with a single pair of short, stout, pointed processes extending basad and laterad from near the tip. Style rather broad, outer point very blunt.

Holotype male, allotype female, and 2 male and 36 female paratypes from Mt. Shasta City, Calif., June 29, 1935, collected by the writer and Mrs. Oman. Also 3 male and 8 female paratypes from south of Mt. Shasta City, same date and collectors. Types in collection of the United States National Museum (No. 52205). In addition to the type series there are specimens at hand from the following localities in Siskiyou County, Calif.: north of Weed (Oman), Bray (Oman), and Dunsmuir (Oman). Specimens of this species are also at hand from Cliffdell, Wash. (Oman), and Cottonwood Flats, Mt. Ranier, Wash. (Oman).

Laevicephalus angelus, n. sp. Figs. 4, 11

Superficially identical with *siskiyou*, but with the dentate projections of the seventh sternite of the female even shorter and the aedeagus with two pairs of pointed processes. Length 3.75–4.25 mm.

Color as in *siskiyou* but with marks on crown either fused or divided and usually not so dark as in that species.

Seventh sternite of female as in *cinerosus* but with median emargination and dentate projections of posterior margin even smaller than in *siskiyou*. Male plates as in *siskiyou*.

Aedeagus shorter than that of *siskiyou* and with two pairs of rather short, curved processes arising from near the tip, one pair extending dorsad, laterad, and slightly basad, the other pair extending laterad and basad and slightly ventrad. Style relatively slender, outer point blunt.

Holotype male, allotype female, and 10 male and 37 female paratypes from above Mint Canyon, Calif., June 8, 1935, collected by the writer and Mrs. Oman. Also 3 male and 11 female paratypes from Mint Canyon, June 7, 1935, same collectors. Types in collection of the United States National Museum (No. 52206).

Laevicephalus joaquinus, n. sp. Figs. 6, 12

Larger, paler, and with less definite markings than *cinerosus*, and with the posterior margin of the seventh sternite of female produced medially. Length of male 4 mm, of female 4.5 mm.

Ground color pale creamy white, oblique, dashes at apex of crown short, markings on disk of crown pale brown. Fore wing subhyaline brown; veins white, occasionally bordered with brown or fuscous.

Seventh sternite of female very short laterally, postero-lateral portions somewhat membranous, posterior margin produced medially and with a very narrow median incision which extends nearly half way to base of segment. Male plates rather broad and short, similar to those of *pacificus* but slightly broader near tips. Pygofer longer than in *pacificus*.

Aedeagus rather slender, bearing near the tip two pairs of short, tooth-like projections in the dorso-lateral and ventro-lateral positions. Style broad.

Holotype male, allotype female, and 1 male and 6 female paratypes from Califa, Calif., June 12, 1935, collected by the writer and Mrs. Oman. Types in collection of the United States National Museum (No. 52207).

ENTOMOLOGY.—*Some new North American Membracidae.*[1] E. D. BALL, University of Arizona.

The writer is planning a revision of the tribe Ceresini along similar lines to that of his Telamoninae and finds as usual that a number of new species must be characterized before it can be completed. The occasion is taken to describe a number of new forms in the different groups.

Ceresa ancora Ball, n. sp.

Larger than *bubalus* with much longer, heavier and strongly recurved horns. The metapodium convex in both diameters. Length 10 mm, width across horns 7–8 mm.

Metapodium widening more rapidly than in *bubalus* to the stout recurved horns that are about twice as long as those in that species, as seen from above the metapodium across the horns is straight in *bubalus* but strongly convex in this species. As soon from the side, the pronotum is arched about as in *bubalus*, not nearly as strongly as in *testacea*. Female segment with a deep triangular notch reaching to the base. Male genitalia of the *testacea* pattern with the genital box usually open, the plates vertical, the styles flat tapering to acute black tips and are incurved and pressed against the plates. The oedaegus long, spatulate, with an acute apex and a pair of backward pointing spines at the base. In *testacea*, the styles are much narrower and more curved, the oedaegus is spoonshaped and the basal spines curve out.

Color green with a submarginal light line on pronotum which broadens and runs up under the horns. The posterior face of the horn and the tip of pronotum brown.

Holotype ♂ and a paratype male Patagonia, Oct. 5, 1935, allotype ♀ and two paratype females Atascasa Mt., Sept. 29, 1935, four paratypes Nogales and four Patagonia taken from the 7th of September till the 20th of October. All taken along the Mexican border in Arizona by the writer.

Ceresa infantilis Ball, n. sp.

Smaller than *vitulus* or *constans*, the smallest species known. With the metapodium strongly convex, shining, and the horns reduced to mere points, scarcely longer than the humerals. Length 6 mm, width 2 mm.

[1] Received September 20, 1937.

Metapodium short, rapidly expanding to the blunt horns, as seen from the side the pronotum slopes to the middle, with a stronger arch than in *vitulus*. The disc of the metapodium is convex, the lateral margins thick and rounding, resembling a *Stictocephala* but with the small but definite horns of a *Ceresa*. Female segment rather long with a deep triangular notch reaching nearly to the base. Male plates short, stout, triangular, held almost vertical by the broad stout styles that are black-tipped and obliquely truncate, behind them an anchor-like structure appears, and then the long oedaegus resembling the head of a needle.

Color (green in life) fading to tawny, the nervures darkening toward the tip. A white margin to the apical part of the pronotum and a white arch on each side starting behind the horn and bordering the curve of the pronotum till it joins the lateral white line.

Holotype ♀ and three paratypes labeled Acapulco, Mex., Aug. 24, 1936, taken at kilometer post 299, allotype ♂ and four paratypes taken at kilometer post 426, three at post 382 Aug. 29, 1936; all taken on the Mexico City to Acapulco Road by Ball and Stone, and five paratypes labeled Guacimo, Costa Rica, June 16, 1903 J.C.C.

This species is described at this time to call attention to the fact that there are two widely different types of male genitalia found in the material that has been included under *vitulus* Fab. This is the oldest (1775) described species and one of the smallest, and as now determined has the widest distribution (from the sand hills of Dakota and Nebraska through both Mexico and the West Indies to most of South America). Goding lists ten synonyms and there are probably others. No one has mentioned the male genitalia in descriptions (although Fowler mentions as a generic character "The elongate styles of the male." He must have seen them in *vitulus*, his first species and assumed that they were generic), but the widely distributed tropical and subtropical species that fits the size, shape of horns and the white arch on the sides of the pronotum of *vitulus* has the plates compressed and the styles extending as long, double curved horn-like appendages, two or three times their length beyond them, while in *infantilis* the styles are flat, swordlike and stand at right angles to the pygofers on either side of the plates. There is a wide variation in horn length in both groups but as far as observed the genital characters are constant.

Stictocephala fulgida Ball, n. sp.

Resembling *collina* Van D. in the smooth, rounding pronotum, still broader and more shining. Pale green with milk-white mottling and a milky "Y" on the dorsum. Length 6–7 mm, width 3 mm.

Metapodium nearly one-half broader than in *collina* and much lower, as low as in *gillettei* but with the metapodium smoother than in *collina* instead of much rougher and more deeply pitted as in *gillettei*. Female segment very short with a broad rectangular notch. Male plates broad at base, slightly inflated before the two tall, curved brown-tipped pygofer spines, then constricted and almost parallel to the broad slightly divaricate tips.

Color pale greenish and milky, polished, the pronotum with milky spots and a definite "Y" running from the shoulders nearly to the apex. The male with the last abdominal segment usually black.

Holotype ♂ allotype ♀ and five paratypes St. Johns, Arizona, Aug. 27, 1934 seven paratypes Granite Dells, Oct. 6, 1929, and two Huachuca Mts., June 15, 1930, all taken in the mountains of Arizona by the writer.

Stictolobus juniperinus Ball, n. sp.

Resembling *trilineatus* Funk, smaller, narrower with the three white lines replaced by five broken lines in front and three pair of white flecks posteriorly. Pale green, lined and mottled with white. Length 6 mm, width 2 mm.

Metapodium low, overhanging the face instead of vertical as in *trilineata*, pronotum slightly sinuate anteriorly, then nearly straight to the slightly depressed apex, transversely rounding instead of laterally compressed. Elytra with three discoid cells as in *subulata*, the apical cell large, triangular, with the petiole usually shorter than the cell instead of longer as in *trilineata*. Female segment long, deeply, acutely notched. Male plates small constricted and depressed between immense flat black-tipped erect pygofer spines, that are narrowed to blunt points and expose a dark anchor-like structure and a long needle-like oedaegus.

Holotype ♂ allotype ♀ and 10 paratypes, Patagonia, Sept. 20, 1930, and eight paratypes Tucson Oct. 20, 1929, all taken in the mountains of Arizona by the writer.

This species is strikingly distinct in its color pattern and unique male genitalia.

Atymna reticulata Ball, n. sp.

Resembling *simplex* Van D. much smaller with a lower crest, size of *querci*, nearly, but with a very different male. Pale green, unmarked except for a row of dots along crest. The elytra with a number of extra cells in the apical part. Length ♀ 6 mm; ♂ 5 mm.

Metapodium much less elevated than in *simplex*, very similar to *querci* but with the apex much more produced. The clypeus produced into an acute point. Venation typical; the apical cell large, almost oval, an irregular number of supernumerary cells in the apical part. Color pale green, the male slightly tawny, a row of fine dots along the crest.

Holotype ♀ and paratype female Santa Rita Mountains, July 13, 1930, allotype ♂ Santa Rita Mountains, July 5, 1933, and a paratype female Tucson, Sept. 29, 1929. All taken in the mountains of Arizona by the writer.

The acute clypeus will at once separate this from any other described species.

Xantholobus arenatus Ball, n. sp.

Resembling *coconinus* Ball in size and general form of the rounding crest, much narrower and less inflated posteriorly and with a "ten pin" color pattern like *nigrocincta*. Female gray with a double saddle. Male tawny gray with a white margined red "ten pin." Length ♀ 4.8 mm; ♂ 4.5 mm.

Pronotum from the side a uniform crescent in the female, low and but slightly curved back of the humerals in the male. In the female tectiform with a double inflation posteriorly and a single median one. The inflations tan colored with white borders on a gray background. Male tawny with white irrorations, the face and below including the femora black. A tawny red, white-bordered ten pin resting on the two humps with a white dot between. Elytra subhyaline, the nervures broad, dark, the appendix smoky.

Holotype ♀ one paratype female allotype ♂ and six paratype males together with the nymphs taken at Leverton, Texas, May 5, 1934, by the

writer. The triangular shape and striking pattern make this species an easy one to recognize.

BRYANTOPSIS Ball, n. gen.

A typical *Polyglyptini* resembling *Publilia* Stal., except that there is a definite anterior horn especially marked in the female, superficially resembling *Metheisa* Fowl, especially in the shape and length of the horn in the male, but differing radically in venation which has warranted Goding in placing this latter genus in the *Smilini*.

As seen from the side with an anterior horn extending obliquely upwards as in *Phyla* for one-third the body length in the female the horn compressed at apex, cut off obliquely and occasionally expanded. There are three lateral carinae. The pronotum covers most of the elytra, is acutely tectiform with four or five lateral carinae, the inner one with branches to the highest part of crest. The face is slightly longer than in *Publilia*, the venation of the elytra similar.

Type of the genus *Bryantopsis ensiger*, n.sp. Named in honor of O. W. Bryant, whose careful and painstaking observations have brought to light this as well as many other rare forms.

Bryantopsis ensiger Ball, n. sp.

Resembling *Polyglyptoides cornigerus* Stal in general size and appearance, but with a much broader horn in the female and different venation which allies it with *Publilia*. Resembling *Publilia modesta* in body shape and venation, larger with a long flattened horn in the female and a shorter pointed one in the male. Length with horn ♀ 7 mm; ♂ 6 mm.

Female with the dorsal line in profile a uniform arch slightly higher than in *P. modesta*. The horn extending upward and forward at an angle of 45° from the line of the costa, strongly compressed, the apex acute and cut off horizontally. The margins are parallel or it is slightly widened at apex. The male horn is about half as long as the female, compressed, but triangular in profile. There are three lateral carinae on the horn and about five on the sides of the pronotum.

Color light brown, the males a little darker, a narrow oblique white band before the apex of pronotum. The tip of horn darker, the dorsal carina broadly light with dark interruptions, the lateral carinae are often light with dark interruptions giving a grizzled appearance.

Holotype ♀ allotype ♂ and 9 pairs of paratypes taken by O. W. Bryant in White House Canyon, Santa Rita Mountains, Arizona, Sept. 25, 1936.

Var. **humerosus** Ball, n. var.

Form and size of the species except that there are large elongated crescentiform ivory or pale yellow areas extending from the humeri half way back on each side. In the male, only the crescentiform margin appears.

Holotype ♀ Huachuca Mountains, July 29, 1935, taken by the writer and allotype ♂ and 6 paratypes taken with the species Sept. 25 and Oct. 5, 1936 by O. W. Bryant.

PROCEEDINGS OF THE ACADEMY AND AFFILIATED SOCIETIES

PHILOSOPHICAL SOCIETY

1105TH MEETING

The 1105th meeting was held in the Cosmos Club Auditorium, October 10, 1936, President SILSBEE presiding.

The program consisted of an invited paper by BRUNO LANGE of the Kaiser Wilhelm Institute, Berlin-Dahlem, and informal communications by Messrs. BRICE and W. J. HUMPHREYS. These were discussed by Messrs. KRACEK, MCNISH, MOHLER, BRICE, and others.

BRUNO LANGE: *The theory and application of photo-electric cells.*—The first part dealt briefly with the photo-electric cell and its physical properties. Tracing photo-electric experiments to Hallwachs, who in 1888 demonstrated the emission of electrons from certain metals when exposed to light, the alkali cells and their limitations were described. The new photo-elements, the development of which was begun in 1884 by Fritts in New York, produce considerably greater currents without booster circuits. In describing the self-generating photo elements in some detail, especial reference was made to their physical and chemical properties by means of actual demonstrations.

The second part dealt with the use of photo-electric cells for radiation measurements, particularly light meters, in conjunction with various filters. With the Multiflex Galvanometer a sensitivity up to 1/100th foot candle per scale division is obtainable. This outfit is of great value in micrometric measurements for microscopes with slit ocular and ocular photo-cell. In describing the recording light meters, it was pointed out that the Multiflex Galvanometer may also be fitted with a photographic recording device to accurately determine the duration of light intensities. A "Sun Motor" the armature of which was rotated by a current generated in a small photo-electric cell, the size of a pocket watch, was demonstrated. It was pointed out that photo-electric measurements can also be made of ultraviolet and x-ray radiation.

The third part dealt with photo-electric elements in optical instruments, particularly in replacing the human eye for accurate measurements of luminosities. The ocular photo-cell on standard microscopes used in evaluating line spectra as well as micro specimens, x-ray films and sound film strips was demonstrated.

The fourth part dealt with special apparatus for testing the permeability of filters. The photo-electric reflexion meter for the rapid and convenient determination of absolute values was demonstrated in detail. Another form, known as the *gloss meter*, is finding applications in many major industries. A colorimeter for turbidity measurements, that will duplicate readings on the same substance, regardless of time elapsed between readings, and unaffected by the visual acuity of the observer, was described. In addition to fluids, solid and powdered substances can be measured, and filters may be employed. It is also suitable for pH measurements. Its application in the determination of iron, manganese, titanium, phosphorous, silicic acid and arsenic, as well as of mercury, of sulphatic ions, of methylene blue, chinolin red, and phenol, aluminum, chlorophyll and vitamin, was stressed, and its industrial applications for the control of signals and switching mechanisms, for water works turbidity control, and smoke alarms aboard ocean liners and

for electric power house generators were discussed. A new type of coherer relay as light barrier and as twilight switch was demonstrated. It was pointed out that invisible rays may be employed for the protection of homes, banks and vaults, introducing a new factor of safety. (*Author's Abstract.*)

In an informal communication, Mr. Brice described and demonstrated a photo-electric apparatus built by the American Instrument Company for the Department of Agriculture, for the purpose of measuring the colors of sugar, resins, etc. In a second informal communication Mr. Humphreys, under the title "Tuckerman vindicated" exhibited a slide of an old print showing the scene after a "ball of lightning" had fallen into a barnyard, and by thus presenting photographic evidence, claimed to have demonstrated the truth of a story attributed to Mr. Tuckerman that such an event had occurred.

1106TH MEETING

The 1106th meeting was held in the Cosmos Club Auditorium, October 24, 1936, President SILSBEE presiding.

The program consisted of an invited paper by KARL F. HERZFELD of the Catholic University of America entitled: *Recent investigations on the liquid state.* Discussed by Messrs. GIBSON, KRACEK, FRANKLAND, HAWKESWORTH, HUMPHREYS, WHITE, and BRICKWEDDE.

1107TH MEETING

The 1107th meeting of the Society was held in the Cosmos Club Auditorium, November 7, 1936, Vice-President GIBSON presiding.

Program: R. L. SANFORD: *Magnetic testing of prison bars.*—A brief description of an instrument developed primarily for the purpose of testing prison bars but which can be used for other practical applications of magnetic analysis. It is essentially an alternating-current bridge whose indications depend upon differences in the shapes of the magnetic hystereses loops of the test specimen and a reference specimen of known quality. The instrument is simple to operate, portable, comparatively rugged, and operates from the ordinary alternating-current lighting circuit. (*Author's Abstract.*)

W. H. SWANGER: *Failures in metals.*—In the examination at the National Bureau of Standards of many metal structural members that failed in service, defective material has seldom been found as the cause of the failure. By far the greatest number of failures resulted because the member, although sound metallurgically, did not have adequate resistance to the imposed service conditions. Resistance to corrosive conditions can be provided by inert coatings. Adequate resistance to service stresses must be provided by the design. Incorrect calculation of stresses or incorrect information on the strength of the material are infrequent causes of failure. Errors in executing the design are frequent sources of failure. Inadequate fillets, sharp re-entrant angles or projecting fins, machine tool marks, constitute points of localized stress concentration which are much more damaging to the resistance of the material to dynamic or cyclic stresses than to static stresses. Fatigue fractures almost invariably originate at a point of localized stress concentration. Corrosion acting simultaneously with cyclic stresses accentuates the localized stress concentration effect, thereby causing a further decrease in resistance to fatigue fracture. Fatigue fractures or fractures resulting from corrosion-fatigue are the most commonly occurring causes of failure in metals used as structural or machine members. (*Author's Abstract.*)

These papers were discussed by Messrs. WHITE, HAWKESWORTH, GISH, HEYL, SALE, TUCKERMAN, and BAECHER.

1108TH MEETING

The 1108th meeting was held in the Cosmos Club Auditorium, November 21, 1936, President SILSBEE presiding.

The program consisted of reports on the Edinburgh Assembly of the *International Union of Geodesy and Geophysics.*

WILLIAM BOWIE: *General report on meeting.*—The Sixth General Assembly of the International Union of Geodesy and Geophysics was held in Edinburgh, Scotland, in September, 1936. There was a large attendance of delegates and guests from thirty-one countries. The assembly was marked with great friendliness on the part of the delegates and a spirit of cooperation in the attack of geophysical and geodetic problems that extended beyond the areas of any one country.

The International Geodetic and Geophysical Union was organized at Brussels in 1919, when delegates from a number of the allied powers assembled to provide an organization that would care for the international aspects of scientific research. There was created at the Brussels meeting the International Research Council with a number of unions. The Union of Geodesy and Geophysics has as branches seven associations representing geodesy, seismology, terrestrial magnetism and electricity, meteorology, hydrology, vulcanology and oceanography. The statutes of the Council and the Union had provisions that were rather distasteful to the scientific men of the central powers. This was inevitable because war fever had not abated in July 1919, when the scientific meeting was held at Brussels. A few years later, however, the statutes were modified and all references to the war were eliminated. There are now thirty-five countries adhering to the International Union of Geodesy and Geophysics although some of them are not active members since they are delinquent in their dues. Guests from Germany and Austria were present at the Edinburgh meeting. It is expected that those countries will join the Union in the not distant future. The Soviet government has decided to adhere to the Union in 1937.

The Union has as its objective the coordination of the efforts of the workers in the fields of earth sciences of all of the countries of the world. Triennial assemblies are held at which the delegates set forth what work has been accomplished, what problems remain and how those problems may be successfully attacked. During the seventeen years of existence the Union and its associations have been very effective in advancing the several branches of the earth sciences with which they are concerned. Without such an organization there would be little or no opportunity for effective coordination of effort.

The opening meeting of the Assembly was a very interesting one with speeches of welcome made by the Lord Provost of Edinburgh, the Principal of the University of Edinburgh, the President of the Royal Society of London and the President of the Royal Society of Edinburgh. These speeches of welcome were responded to by the President of the Union. Aside from the scientific meetings of the Union, the associations and the committees, there were a number of social events, which were enjoyable in themselves and which enabled the delegates and guests to become better acquainted.

One of the outstanding accomplishments of the Assembly was the creation of a committee on Continental and Oceanic Structures, of which Prof. RICHARD M. FIELD of the Department of Geology of Princeton University

is chairman. It is expected that a committee in each of the adhering countries will be organized for the purpose of cooperating with the international one. Another event that occurred which is of interest to all American scientific men was the unanimous decision to accept the invitation presented by the chairman of the American delegation to hold the next general assembly of the Union at Washington, D. C. in 1939.

There were 33 delegates and 18 members of their families representing the United States at the meeting in Edinburgh. They were unanimous in their praise of the Assembly and of the friendship and courtesy shown by the officials and citizens of Edinburgh. (*Author's Abstract.*)

W. D. LAMBERT: *Report on geodesy.*—The work of the Association of Geodesy at Edinburgh was done mainly in committee. The speaker reported briefly on those committees the sessions of which he was able to attend. These were: (1) Earth tides; (2) Variation of Latitude; (3) Gravity; (4) the Geoid. Oddly enough, the last-named committee is a new one. A center to further the work of isostatic reduction was established under the direction of Prof. HEISKANEN of Helsingfors. He expects to do the work mainly with the aid of his students; he will receive a small grant from the Association and perhaps a further grant from the Finnish Government.

A Committee on Continental and Oceanic Structure was established by the union. This is an inter-associational committee to promote the application of geophysical methods to the large-scale problems of geological structure. Prof. R. M. FIELD of Princeton is chairman and Dr. J. A. FLEMING is secretary; the membership includes geologists as well as geophysicists of various sorts. (*Author's Abstract.*)

E. W. EICKELBERG: *Report on seismology.*—The history of the International Seismological Association itself merging with the International Association of Geodesy and Geophysics and American participation in the meetings was reviewed. From the contributions of the adhering countries the Secretary maintains the Central Bureau at Strasbourg, France. Normal expenses include the reports of meetings, preliminary determinations of earthquake epicenters, support of the International Seismological Summary and other useful activities. The purpose of the meeting was to report progress, discuss new projects and present papers of broad significance; and to standardize methods. Among the subjects discussed were the significance of the first motions given on the earthquake record and the importance of making this information available. Methods of developing travel time tables and curves received consideration. There were discussions of papers by delegates from the United States covering a wide field of activity and among them a discussion of shaking platform tests at the National Bureau of Standards by WENNER and MCCOMB and the torsion pendulum as an accelerograph analyzer, by NEUMANN. Four members of the PHILOSOPHICAL SOCIETY were on the program.

The national reports show that the United States is well to the fore in seismological investigation. A joint Commission on Ocean Basins was formed to study the application of geophysics in this part of the earth. There were several excursions to regions where known faults are associated with earthquake activity. (*Author's Abstract.*)

J. A. FLEMING and L. V. BERKNER: *Report on Terrestrial Magnetism and Electricity.*—The Edinburgh meeting of the Association was noteworthy because of its distinctly international aspect. Sixty-five delegates and guests represented 17 countries—Austria, Australia, Czechoslovakia, Denmark, Finland, France, Germany, Great Britain, Holland, Japan, Latvia, Norway,

Poland, Portugal, Sweden, Switzerland, and the United States of America. Eight meetings were held. Part of a day was taken in one joint meeting of the Commission on Oceanic and Continental Structure and one full day was given over to a delightful excursion to inspect the Eskdalemuir Observatory. There were 20 reports from national committees and over 60 communications, the majority of which concerned researches requiring international coordination and cooperation.

Good progress in the geophysical sciences during the three years since the Lisbon Assembly was reflected in the address of the President, in the report of the Secretary, and in the reports of the national committees. Of particular significances were the important advances indicated by the presidential address and the suggested directions which future geophysical investigations might advantageously follow. The President noted the full cooperative and harmonious relations maintained by the Association with the Commission of Terrestrial Magnetism and Atmospheric Electricity of the International Meteorological Organization. These relations make the two bodies of mutual benefit and assure elimination of duplication of effort and expense. The wise use of the Association's resources, both moral and financial, in support of the Polar-Year Commission's Bureau in Copenhagen has greatly advanced the reductions of data obtained during the second Polar Year.

An outstanding announcement at the meeting was that by the Hydrographer of the British Admiralty who informed us that the plans for the nonmagnetic vessel *Research*, to resume the magnetic and electric surveys of the oceans originally carried on by the *Carnegie*, had been completed, and that in this effective assistance had been received from Mr. W. J. PETERS of the Carnegie Institution of Washington as also in the design and plans for the necessary instruments to be used on board. He further advised that just as the meeting was being held the contract for the construction of this vessel, which is but slightly larger than the *Carnegie*, had been let at a cost approximately twice the original estimate. Other outstanding events since the Lisbon meeting include development of magnetic observatories in the world net, more intensive research of observational data, progress in international magnetic standards, and development of methods for recording continuously electric conditions in the ionosphere.

Nineteen resolutions pertaining to international research and cooperation in the fields of our Association were adopted. Emphasis was laid on the necessity of distributing adequately publications of the Association in a resolution adopted also by the Union as a whole. The preparation and publication of a list of magnetic and electric observatories, together with a thesaurus of values, was authorized, this material to be prepared by the Department of Terrestrial Magnetism of the Carnegie Institution of Washington and the Potsdam Observatory of Germany. The necessity of control of variometers and of examination at regular intervals in the operation of observatories was emphasized. The Association recommended that every observatory provide means to secure registration of extreme values during severe magnetic storms and also that reproductions of magnetograms be supplied the Central Bureau of the Association for photographic reproduction on film, thus permitting economical and widespread distribution of records for purposes of discussion and study. A committee was appointed to consider and report during the next three years upon steps to promote international intercomparisons of magnetic standards. Two resolutions dealt with the effect on magnetic observatories of electrification of railways, and it was requested that information concerning effects be sent to the Central

Bureau of the Association so that material might be available for the use of those organizations whose effectiveness is threatened by proposed electrification of railways.

It was agreed to continue the magnetic character-numbers on the scale of 0, 1, and 2, and also the numerical magnetic activity-figures according to the agreement at the Stockholm Assembly in 1930 but to replace the sum (HR_H+ZR_Z) by the daily range of declination expressed in minutes of arc. Arrangements were made for the printing and distribution of activity-figures for the Polar Year 1932–33 and for the extension of magnetic character-numbers to observatory results obtained prior to 1906.

The importance of suitable arrangements by all governments for the complete realization and continuation of the minimum program for international repeat-observations as adopted at the Lisbon Assembly was emphasized. A resolution was passed congratulating the British Admiralty, the Astronomer Royal, and the Chairman of the British National Committee for Geodesy and Geophysics upon the realization of the plans for the non-magnetic ship *Research*, and it was suggested that other maritime nations should consider the construction of such non-magnetic vessels. Already the U.S.S.R. is building a ship for such investigations in the arctic seas and the Japanese Government is making arrangements for magnetic observations at sea.

The reports of frequent records during the International Polar Year of giant pulsations in Iceland led to the adoption of a resolution authorizing the Executive Committee to arrange for the installation of recording variometers in Iceland and to invite collaboration of magnetic observatories. This phenomenon is one which seems to be somewhat local in character.

With regard to investigations in atmospheric electricity, a resolution was adopted recommending continued investigations of the atmospheric-electric elements at observatories now recording their variations and the initiation of such studies at other observatories. It was especially emphasized that observational data about the electrical state of the troposphere and of the stratosphere over land and sea should be augmented.

Emphasis was given in a resolution on the need of more earth-current data and the provision of additional earth-current stations at well-distributed points and especially on islands surrounded by the deep sea. It was recommended that the field-intensity component of the electric current in the Earth be taken as positive when it corresponds to a flow either towards the north or towards the east and, further, that the azimuth of the resultant earth-current intensity-vector be reckoned from north through east to 360°.

The desirability of prompt publication of Polar-Year data was expressed in one resolution. The Association is in favor of having a classification of literature on terrestrial magnetism and electricity drawn up as a part of the international decimal system.

To carry on the activities of the Association until the General Assembly which is to be held in Washington in 1939, existing committees were continued as follows: On the selection of sites of new observatories for terrestrial magnetism and electricity; Auroral committee; Committee on the study of the relationship between solar activity and terrestrial magnetism; Committee on magnetic secular-variation stations; Committee on the study of electrical characterization of days. Three reporters were designated, namely: On numerical characterization of days, on international collaboration for promoting the study of the influence of the moon on geophysical phenomena, and on ion-counters.

One joint committee of the International Commission of Terrestrial Magnetism and Atmospheric Electricity and of the Association was continued, namely: On methods and codes to adequately describe magnetic disturbances and perturbations. A joint committee of the International Scientific Radio Union and of the Association was also formed. New committees were established as follows: On magnetic charts—(1) organization of work, and (2) methodology; on registration of giant pulsations in Iceland; on methods of observatory-publication; on classification of magnetic literature; to promote comparisons of international magnetic standards.

Administrative matters included the adoption of statutes and election of officers. The new officers are as follows: President, FLEMING; Vice-Presidents, MAURAIN, and CHAPMAN; Secretary and Director of Central Bureau, GOLDIE; additional members of the Executive Committee, KERÄNEN and TANAKADATE through 1939, and VAN DIJK, CRICHTON, MITCHELL, and STÖRMER through 1942.

In conclusion, this Assembly of the Association has shown fruitful collaboration and progress during the last three years; it is to be hoped that the ever-widening prospects presented may furnish ample incentive to achieve further understanding and interpretation of the many experimental data nature so generously provides. (*Author's Abstract.*)

Mr. WEIGHTMAN: *Report on meteorology.*—In organizing the program for the meeting it was decided to adopt as the basic theme *The problem of atmospheric disturbances*, which resolves itself quite easily and naturally into six separate divisions covering the different branches of meteorology, as follows: (A) Definition of the disturbances; (B) Origin of disturbances; (C) Structure of cyclones; (D) Interaction of different atmospheric layers; (E) Radiation and its role in atmospheric disturbances; (F) Precipitation, rime and fog. In addition to seventeen papers on the first five of these divisions, there were about a dozen of a nature difficult to classify under the above heads. The papers were mentioned by title and some comments made concerning a few of them.

The meetings were well attended and many interesting discussions followed the reading of the papers. A few of the papers were read by title. In all, it was the feeling of the delegates that the gathering had been an unqualified success. The officers elected were as follows: President: Dr. S. CHAPMAN; Vice-Presidents: P. WEHRLE and W. R. GREGG; Secretary: J. BJERKNES.

1109TH MEETING

The 1109th meeting, constituting the 66th annual meeting, was held in the Cosmos Club Auditorium, December 5, 1936, President SILSBEE presiding.

The treasurer reported that exclusive of liquidation of securities the income of the Society during the past fiscal year was $1400.26, the expenditures, excluding reinvestment of funds, amounted to $1410.71. The fiscal year was entered with $1000 of the investment account in cash. During the year $500 of the invested funds of the Society were liquidated and $1386.29 were invested.

The treasurer's report showed an active membership of 298 of whom 255 were in good standing.

The secretaries reported the following were elected to membership during the year: S. F. ACREE, NORWOOD ADAMS, N. G. ANDERSON, C. E. BENNETT, W. M. BLEAKNEY, HORACE R. BYERS, IRWIN L. COOTER, R. C. DARNELL,

CHARLES E. GAUSS, KARL F. HERZFELD, PETER HIDNERT, D. P. JOHNSON, H. PAUL KAUFMAN, M. FALL KERBEY, R. H. LEE, A. HUGHLETT MASON, G. H. MORSE, OSCAR NORGORDEN, ERNEST J. PARKIN. FRANCIS E. WASHER, ALBERT WERTHEIMER, H. M. WOOLEY.

The following deaths were reported: CHRISTIAN HUFF (a member since 1926), HENRY B. HEDRICK (a member since 1918).

The following officers were declared elected for the year 1937: *President*, F. WENNER; *Vice-Presidents*, F. G. BRICKWEDDE and E. W. WOOLARD; *Recording Secretary*, H. E. MCCOMB; *Treasurer*, W. G. BROMBACHER; and Members-at-large of the General Committee, F. E. JOHNSTON and J. A. DUERKSEN.

During the year the sixth Joseph Henry Lecture, in memory of the first president of the Philosophical Society, was given by HERBERT DINGLE, Imperial College of Science and Technology, London.

At the conclusion of the business meeting a humorous talk was presented by G. GAMOW entitled *Cosmos-rays*.

Informal communications were presented by Messrs. A. G. MCNISH and E. TELLER.

L. R. HAFSTAD, *Recording Secretary*

1110TH MEETING

The 1110th meeting was held in the Cosmos Club Auditorium, Saturday, December 19, 1936, President WENNER presiding.

Program: T. WAYLAND VAUGHAN: *Notes on Proceedings of the Association of Physical Oceanography, September 17 to 24, 1936, at the Sixth General Assembly of the International Union of Geodesy and Geophysics in Edinburgh.*

Officers. The President of the Association was Martin Knudsen, Vice-President, E. Fichot, Secretary, J. Proudman. The members of the Executive Committee who were present were D. J. Matthews, B. Helland-Hansen, and Thomas G. Thompson. Since the meeting in Lisbon in 1933 two members of the Executive Committee, J. Joubin and G. Magrini, had died. T. Witting, Caballero y Lastres, and Odón de Buen were absent.

Attendance. Although I made no attempt to keep a record of the attendance at the different sessions of the Association, I noted that there were representatives from the following countries: Austria, Denmark, Finland, France, Germany, Great Britain, Indo-China, Monaco, Morroco, Netherlands, Norway, and the United States of America, making twelve countries altogether. A few other countries may have been represented. The total attendance at the sessions was about fifty, but, again as no accurate record of those who were present was kept, there may have been a few more. One or more representatives from each of the countries listed presented papers or took part in the scientific discussions. It is to be regretted that several countries that are active in oceanographic research were not represented, for instance the U.S.S.R. and Japan.

Regions covered by Scientific Papers. There were scientific papers on the Norwegian Sea, Atlantic Ocean, Mediterranean Sea, Indian Ocean, and Pacific Ocean including Bering Sea. One paper dealt with the seas surrounding Antarctica. A regrettable gap in the program was that we had no paper on the Arctic Ocean.

Subject covered. Nearly every aspect of physical oceanography received consideration. There were papers on the determination of gravity at sea, bottom configuration, marine bottom deposits, oceanic circulation, tides,

submarine solar radiation, the chemical features of sea water, and the interrelations of the sea and the atmosphere. Reports on the result of several important expeditions were presented and accounts were given of the work of leading organizations, such as that of the International Hydrographical Bureau.

Cooperative Projects. A number of projects that require international cooperation were discussed. Among them were: a proposal for an international survey of the Gulf Stream area; the units which should be used in the specification of the different common constituents of sea water and on the necessity of a world-wide uniformity of procedure; the desirability of fixing standard levels for oceanic observations; the new edition of the general bathymetric chart of the oceans; the criteria and nomenclature for the major divisions of the ocean bottom; the study of ocean swell in the proximity of shore and a plan for the international study of marine erosion on the seashore; and the organization of geophysical work in the Mediterranean sea. There were discussions jointly with other associations of the Union. One of these, the interaction between the sea and the atmosphere, was at a joint meeting of the Association for Meteorology and that for Physical Oceanography. Another joint discussion with other Associations was the use and value of geophysical methods in the attack upon the structural problems of oceanic and continental areas. The discussions were very stimulating, even inspiring.

Committees. The old Committees on tides, mean sea level and its variations, and (jointly with other Associations) the study of so-called tidal waves (raz de marée), were continued. Several new Committees were appointed covering several of the subjects that were topics for general discussion. Among these there were committees for an international survey of the Gulf Stream, for the units to be used in the specification of the different chemical constituents of sea water, for the designation of standard levels for oceanic observations, for the criteria and nomenclature of the major division of the ocean bottom, and jointly, with the Association for Meteorology, one on the interaction between the sea and the atmosphere. As I did not take down the names of all those who were appointed as members of the different Committees, it seems inadvisable to give an incomplete list.

New Officers. The following officers of the Association were elected, B. Helland-Hansen, President; Fichot, Vice-President; J. Proudman, Secretary.

During the meeting there was on September 19 an excursion of particular interest to the oceanographers, on the Scottish Fisheries steamer *Explorer*, under the able leadership of J. B. Tait, hydrographer of the Scottish Fisheries Service. It was an all day excursion on the Firth of Forth. The vessel went from Leith docks to the mouth of the Forth. On the excursion Mr. Carruthers gave a demonstration of the use of a current meter designed by him; and D. J. Matthews demonstrated the use of a frameless water bottle recently designed by him. On the same day there was a parallel excursion on the *Armauer Hansen*, the research vessel of the Geophysical Institute in Bergen, under the leadership of Helland-Hansen. Those who took part in the excursion had an opportunity to see both vessels.

Conclusions. From the notes above made it will be seen that great interest was manifested in the proceedings of the Association by the presence of delegates from many countries and the rather large attendance at the different sessions of the Association. Nearly all of the important oceanic areas of the world were considered and there were papers of high quality on almost every aspect of physical oceanography. Many projects requiring interna-

tional cooperation were discussed and committees were appointed to bring about appropriate international action. The meeting was very successful. (*Author's Abstract.*)

Discussed by Messrs. McNISH, HUMPHREYS, SMITH and WENNER.

O. E. MEINZER: *Notes on Proceedings of the Association of Hydrology, September 1936, at the Sixth General Assembly of the International Union of Geodesy and Geophysics in Edinburgh.*—The outstanding feature of the hydrology meetings in Edinburgh was the three-day conference on snow, conducted by the Commission on Snow, with the cooperation of the Commission on Glaciers. This conference was arranged through the energetic and cooperative efforts of Dr. J. E. Church, of the University of Nevada, who was the organizer of the Commission on Snow and is still its Chairman. Unfortunately, on account of serious illness in Moscow, he did not reach Edinburgh until after the snow conference, but the conference was nevertheless very successful. The American Section of Hydrology was represented by four eminent authorities on ice and snow, namely, Professors Hobbs and Gould and Messrs. McLaughlin and Elges.

At the regular hydrology meetings about one day each was devoted to the Commissions on Streams, Lakes, Underground Waters, and Practical Applications, and many important problems covering a wide range in the science of hydrology were discussed. The meetings were attended by a small group of able hydrologists, most of whom have a broad scientific interest in hydrology but with less specialization than among the hydrologists in the United States. There was an enthusiastic delegation from France and most of the smaller European countries were represented by one or more able men, among whom I may mention Mr. Smetana, of Czechoslovakia, the genial and energetic President of the Association of Hydrology, Mr. Lutschg, of Switzerland, the President elect, and Mr. Slettenmark of Sweden, the Vice-President elect. Mr. Dienert, of France, continues as the Secretary of the Association.

Action was taken to hold a round table at the Washington meeting in 1939 on the problem of making greater use of the hydraulic laboratories in research in hydrology and other departments of earth physics.

Discussed by Messrs. VAUGHAN and HECK.

H. E. McCOMB, *Recording Secretary*